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COMPENSATION OF WORKMEN AND EFFICIENCY OF OPERATION.

By H. L. Gantt.

Mr. Gantt's work is widely recognized as one of the great contributions to the search for a better, more just, and more stable basis for the payment of wages. The discussion which he has here undertaken is the most complete and intimate demonstration of his philosophy and his practice yet given to the public. In a preceding article he discussed day-wages. The present section takes up piece pay. A following part will deal with "Task and Bonus," and a concluding paper will show, by most interesting colored charts, the actual results obtained under the system in a diversity of occupations and conditions.—THE EDITORS.

THE one fact underlying the philosophy of labor management developed in the preceding article, is that it is not the workmen who are chiefly at fault for the inconsistency and inefficiency of most payroll disbursements, but the system generally used in handling the workmen. Under the system that oftenest exists we cannot expect the workman to be much different from what he is. If we were in his place, we should probably do as he does. We should want to make the best living we could for our families, and if by working honestly and conscientiously we could not make any more money, and if we had tried it over and over again, and still could not get any more, even though we did twice or three times as much as the poorer worker beside us, we should do the same thing the average worker now does; namely, come to the conclusion that the system under which we were working had no provision for compensating the individual according to his deserts, and that the only way we could get more money for our services would be to get the wage rate of our class raised, and take steps to this end.

This is exactly what the men do. The employer has forced them into a class by keeping their wages uniform, and it is but a short step

from such a class to a union. With the union comes first collective bargaining, then demands, then strikes. This is a logical series, for a successful bargainer always wants a better bargain next time, and the demand that is successful is very apt to be followed later by one that will yield more still, even if it takes force to sustain it.

As was said in the previous article, most workmen are good citizens, and if we can show them peaceful means by which they can get equitable compensation, they will have but little desire to resort to force. As has been said before, we recognize that our method of keeping individual records and compensating the individual accordingly is not easy, and in many cases may be impossible, but we have found that an honest effort to do it has always produced a feeling of confidence and loyalty among the workmen, which added much to their efficiency.

Piece Work.

So far our discussion of the subject has related only to day work. An investigation of the subject of piece work also reveals inconsistencies similar to those already considered.

In the term piece work we include all the various schemes for compensating men for *what they do*, instead of for *the amount of time they work*. It may be divided into two general classes.

The first is that in which a price for a job is set from previous records or from the estimate of a foreman, who generally considers his duty done when he has set the price.

This method is the one in general use and until recently it has been almost exclusively employed. In recent years, however, it has been very generally modified in order to avoid the troubles that have so frequently followed such piece work in the past. The following reasons seem to be amply sufficient to account for the labor troubles that have been caused by this kind of piece work.

Records of what has been done are only a very poor indication of what can be done by a capable and industrious workman, and still may be far beyond the possibilities of an ordinary workman who has not had special training in the work.

Estimates of a busy foreman as to how long it should take to do a new job must necessarily be inaccurate, and rates set by his estimates are practically guesses. After the workmen have become skilled, their earnings will increase greatly and will often be out of all proportion to the exertion put forth.

Under these conditions an adjustment of the prices based on the new records is made; and, as the workmen become more skillful, it

is done again. Thus the more skilled the workman becomes, and the more progress he makes, the greater the penalty he has to suffer, for his prices are being continually reduced so that he earns but little more than the incompetent man, who has never been able to do his work in such a manner as to exceed greatly the old records.

The effect of this method of *penalizing the good workman* in proportion to his increased effort is to discourage him so that he learns ultimately to limit his output by that of the poor workman. This result is so natural that we should not be surprised at it, nor should we condemn it, unless we make it to the interest of the workman to do otherwise. His desire for more money continues, however, and when he finds his piece rate reduced whenever he earns much more than the average workman, he comes to the conclusion that as his employer seems determined to keep him in his class so far as compensation is concerned, he will see what he can do to better the financial condition of the class.

The fact that he has had to suffer a penalty for trying to advance himself by legitimate methods, however, has caused him to feel that *might* is more powerful in the world than *right*. No better way could possibly be taken to teach him the value of force in accomplishing his ends.

We cannot blame him if he now spends his extra energy in forming his union, for in the past unions have done more for the workman than he could do for himself. If we wish him to abandon the use of force, we must assure him of an equitable return for his efforts without it. Inasmuch as in the union, as was previously shown, the good man seldom gets all he is worth, we can get the good men on our side, if we can convince them that their efforts will be adequately rewarded.

This brings us to the second system of piece work, which when properly operated provides a complete system of instruction for the workman, equitable compensation for his efforts, and opportunity for advancement on his own merits, and not through "pull" or friendship. So far this system has never failed to create a strong spirit of harmony and co-operation.

The essentials of this system are:

First, to have the best expert available investigate in detail every piece of work, and find out the best method and the shortest time for doing it with the appliances to be had.

Second, to develop a standard method for doing the work, and to set a maximum time which a good workman should need to accomplish it.

THIRD, to find capable workmen, who can do the work in the time and manner set, or to teach an ordinary workman to do it.

FOURTH, whenever the high efficiency is obtained, to compensate liberally not only the workman actually doing the work, but also those who supply him with materials and appliances to enable him to maintain the efficiency specified.

FIFTH, to find among the workmen who have learned the best ways of doing work, some that can investigate and teach, and thus gradually to get recruits for the corps of experts, so that the system may be self-perpetuating.

SIXTH. The ordinary foreman of the shop *must not* be called upon to do the work of the expert. His business under the usual conditions of management is that of an executive, and he is invariably so busy attending to his routine duties that he has but little time to make investigations into the best method of doing work. He can only give instructions according to the experience he has had in the past, or according to the knowledge he may pick up at odd times. Again, he frequently feels compelled to allow work to be done inefficiently because he has no man that can do it better, and no time to train a new man. For these reasons it is desirable that the development of improved methods, the setting of tasks in accordance with these methods, and the training of workmen to perform these tasks, should be in the hands of some one other than the foreman.

For this purpose the best expert mechanic available should be selected. Such a man may not have qualities at all fitting him to be a foreman—in fact, the best expert usually makes but a poor foreman. He is generally so absorbed in the mechanical operations themselves that the improvement of them becomes a passion with him, and nothing pleases him more than to see numbers of machines operating at their highest efficiency, the result of his work. On the other hand, the foreman with this kind of a mind often sacrifices other sources of efficiency for this object. The expert must be a good mechanic, with fair education. He must have industry, originality, persistence, and an ability to remove obstacles, not once, but repeatedly.

Such an expert in a shop will study the machines individually and teach workmen to bring each up to its highest efficiency.

While the policy advocated in the above paragraphs cannot be called a system of management, the elements described must be parts of any good system. Each individual problem of manufacture must be studied in such a manner as to determine how the work can be done in the most efficient way possible.

There is no use in attempting to increase efficiency, however, unless it is done in a systematic manner. Managers will often tell you that you cannot put into their shops methods of this character, and, under the conditions that exist, they are right. In many places you cannot at once better the evident inefficiencies that exist, for the machinery is often so arranged that it is extremely difficult to do anything different from what is already being done.

Most plants have grown from small beginnings, and have been added to without any definite plan, or any real idea of the system to be used in operating them. In many cases the character of the work has changed, and a plant well adapted for one class of work may be so arranged as to make it impossible to do another class of work efficiently. Then there are plants in which the machinery has been arranged without considering the subject of efficient management. In most plants, at least one of the above conditions exists to such an extent that much of the machinery must be rearranged to make any great improvement.

Then there are some people who have no idea of doing anything in a systematic manner. They cannot do anything twice the same way. They may be very good people, with an artistic temperament, perhaps, or they may be chronic inventors. They like to change things. If you have a man like that at the head, and succeed once in getting the plant organized for efficient work, he will want to change things again tomorrow. Such a man is not a manufacturer, and will make a much greater success at something else. To attempt to make permanent under such a man an efficient arrangement of machinery, or system of management, is futile.

On the other hand, if the man at the head is systematic, and while capable of recognizing an improvement, is slow at making changes unless he can see distinct benefit from them, the conditions for instituting such reforms as will permanently add to the efficiency of the plant are ideal.

When we have once established our system of management by which the work is done economically, and the workmen get higher pay, they themselves offer the strongest opposition to change, for they will stand by a good system under which they are benefited quite as staunchly as they did by the forty-year-old method it replaced, the only virtue of which, perhaps, was its age.

Before beginning to introduce the methods described we must study the conditions under which the work is to be done. The machinery must be so arranged that the work can be done economically,

and provision must be made to have the proper materials and appliances always available for the workmen. This is a question of management, and may have quite as much effect on the proper operation of a plant as anything the workmen can do.

Having placed our machinery so that it can be operated efficiently and arranged for a proper provision of materials and appliances, the first problem is to determine the best way of doing a piece of work. Usually there are in every shop some workmen who are much more capable than the others. If the best of these can be interested in our work, the problem of studying the work in detail is much simplified. In connection with such workmen, our observer, or "time study" man, can make a detailed scientific study of all the elements of a piece of work and determine the best method for doing it and the shortest time in which it can be properly done by an experienced man working at his best normal speed. Having determined such a time and method, they are adopted as standards, and the workmen should be awarded liberal compensation for doing the work by the method and in the time set.

As a rule it is best to study, if possible, the work as done by several good workmen. If it is understood that the most efficient will be given the work at a fair rate, we are usually able to secure their co-operation in fixing that rate.

If it is necessary to train several workmen, the very best man should be made an instructor and compensated liberally for teaching the others his knowledge and skill.

In machine shops, or other places where many tasks are to be set, the investigator or task-setter should be the most expert workman available, and his compensation should be such as to make him jealous of his job. If any workman often succeeds in doing the work in less than the time set, we mark him—not to have his rate cut—but as a promising candidate for an instructor's or task-setter's job. As a matter of fact, our trained workers often yield a good supply of instructors and occasionally a task-setter.

We thus provide means for the workman to learn the best practice we can devise, and not only compensate him liberally for following it, but give him a chance to advance himself still further if he has the ability to do so.

When it is clearly understood that we mean to do this, we have no difficulty in getting the hearty co-operation of the workmen.

After a proper study we should know the time needed by a good man to do the work with the same certainty that we know it is possi-

ble for a good healthy man to walk four miles per hour for several hours. We know, however, that if we go out into the street, and ask a dozen men at random to walk to a place four miles off in an hour, they will all probably have great difficulty in doing it. If we ask them to go eight miles in two hours, the great majority of them will fail. If we extend the walk to twelve miles in three hours, almost none of them will accomplish it. Suppose, however, we know a man who can walk four miles per hour readily, and get him to teach others to do it. If we make it to the interest of the others to do as they are taught, our expert can soon teach them by walking them, perhaps, the first day, only one mile in a quarter of an hour; the second day, two miles in half an hour; in a day or two, four miles in an hour, then six miles in an hour and a half. He soon gets them so they can walk day after day at that rate without any difficulty. We have the same problem in doing any kind of work. If a man is trained to do a certain kind of work at a certain speed, he will do it at that speed, even though it may have been absolutely impossible for him to do it at that rate before he was trained.

Training takes time, and training a man to work rapidly and well is a much more difficult job than training a man to walk fast. Therefore, after our expert has found the best way and the best speed for doing certain work, his job is still often only half done. He must find somebody who can be trained to do it in that way and at that speed. Frequently we know it should be done at that speed, but cannot find anybody to do it. Our investigation may show that a job can be done in an hour, and yet the best result we can get may be an hour and a quarter, or an hour and a half. Every worker in the place may say he cannot do it, and nobody may be willing to try. But if our studies are correct, and if we patiently train people, experience proves that we can eventually get someone who will do it.

If the man who is doing the work is successful in performing his task in the time and manner specified, he of course gets extra compensation; but this is not enough. The men who supply him with the means of doing the work must also get extra compensation, for unless you can make it to their financial interest to co-operate, the worker may fail for want of their co-operation. On the other hand, if they do get extra compensation when the individual is successful, there will be a complaint from someone if he is not successful. If his failure is due to the man supplying the materials this man will be criticised, not so much by the superintendent as by the workman himself. If the workman often fails from his own inefficiency, the helper, who

also loses, will complain. Not long ago an illustration of this occurred in a cotton-mill. A slow-moving fellow you would hardly think could do a full day's work, finally woke up, and became a good weaver earning his extra compensation nearly every day. One day the proper filling was not ready for him in time. The foreman heard a great row in the weave room, and looking around, found this fellow about ready to take off the head of the man whose duty it was to supply the filling. That man had energy enough, but he had only recently learned to use it, and the object-lesson he gave helped the whole room.

After we have studied a job and set the task, it should be our invariable rule never to change it unless we change the method of doing it. If, in spite of careful study, we find we have made a mistake, we must simply accept the consequences of that mistake. We may some day find a better way of doing the job. In this case we may change the task by adopting that as our method, and teaching it to the workmen. As long as the work is done by the same method, however, we should seriously impair the efficiency of the whole place if we attempted to increase the difficulty of the task. Suppose we have decided after careful study that 10 pieces is a day's work. If our people become exceptionally skillful and do 12 or 14, it is well worth our while to have them do so.

On the other hand, if an attempt is made to increase the task as the workers become more skillful, the workmen will logically decline to do the increased task, if the original task is a fair one. Suppose the employer insists on his point, and lets his trained workers go. If his task is a proper one, his new gang will be unable, as a rule, to do more than half as much as his trained gang, and hence he will need twice as many people and twice as much space to get out the same product. Twice as many people require at least twice as much supervision, and if they are untrained and new in the shop, more than twice as much. In addition, the product of the untrained workers is sure to be decidedly inferior to that of the good workers, and altogether the loss to the employer is likely to be many times the possible gain by the saving in wages.

When therefore we have a lot of efficient men, working harmoniously, we can afford to pay them big wages rather than try to change things at all. A certain mill formerly had the reputation of paying poor wages, and of course had difficulty in getting good help. Now, under this system, it pays the best wages and draws the cream of the

help from all around. Every man in that mill knows he has the best job he can get, and he comes every day to take care of it.

If the men know that the employer will stand by his word, and not change the time for performing a task when it has been once set, they soon get confidence in him, and the problem of increasing the efficiency of the plant becomes easy.

In attempting to increase the efficiency of a plant, then the first problem is to convince the workmen of our good faith and that they will be treated fairly. When this has been done, we always have their co-operation to a degree entirely unsuspected by those who have never tried that method.

We must remember, however, that proper piece rates and loyal workmen are only elements in producing efficiency. They have but little effect unless there is system of management that tends to harmonize all the various elements upon which efficiency depends.

In fact, a broad-minded manager who understands the relative importance of the various operations carried on in the plant, and who adopts a policy which has a tendency to harmonize these various operations, can accomplish more with individual records and day work than can be accomplished by the best possible piece rates without a harmonizing system of management.

In any attempt to increase efficiency, therefore, the first problem is to harmonize the various operations. In most plants, especially those that have grown gradually from small beginnings, it is usually possible for a capable man to do this in a manner that will increase efficiency, diminish the amount of supervision needed, and secure the co-operation of the best men, if he makes a careful study of the work with that object in view.

To do this it is often necessary to rearrange machinery in order to minimize transportation and bring together similar and allied operations. This should be done before a study is made of the detail operations, which if possible should be studied under the conditions that are to be permanent.

In other words, the general problem of manufacture must first be divided into its grand divisions; these grand divisions must then be divided and subdivided until the individual operations may be further subdivided into details which can be studied separately.

Analyzing a piece of work into its proper elements and determining the minimum time for each element is not work that can be done by an inexperienced clerk with a stop watch, but requires a man with a trained analytical mind who can concentrate his attention on a

problem and learn all there is to be known about it. Having determined the minimum time in which the work can be done, the problem of setting a reasonable task is still to be solved. If the work is simple and is to be repeated many times per day, and day after day, the task should be a difficult one for even the good workers at first, for with repetition they will acquire skill, and in a short time it will become easy. In such work it will often pay to spend quite a long time training workers to do it efficiently.

If, on the other hand, the operation is but seldom done, it may not pay to spend much time training workmen to do it with great efficiency. In this case we should not make the task too severe, but such as a good workman can do without special training.

This studying of the elements of a piece of work and setting proper tasks or piece rates, though an important part of any proper system of management, is only a part. The broad problem which includes all others is to develop a system that encourages the study of all operations and adequately rewards all that co-operate for their continued efficient performance.

As was said before, it is not the workman to whom we must look for increase in efficiency, but the manager. The policy of compensating the individual for efficiency is bound to cause increase of efficiency, and that of fixing compensation regardless of efficiency is just as sure to reduce it. The manager, and not the workman, is responsible for the policy.

It is a well recognized fact that the efficient man at high wages is much more profitable to his employer than the inefficient man at low wages, yet how many managers give any consideration to the subject of increasing efficiency? Under the system of management in most general use the manager puts the solution of all problems concerning workmen on his superintendents, who in turn pass them on to their foremen.

Is such a policy a system of management, or is it a system of shirking the responsibilities of management? Of course the manager cannot personally study all the operations, and solve all the labor problems that may come up; but if he has the knowledge and ability he can gradually build up an organization that will do so.

The demand for trained workmen is very extensive, but it too often spends itself in schemes for schools to carry out at their own expense, and the question immediately arises as to whether the schools, or, in other words, the State, should bear the expense of training workmen. Under the old apprentice system each trade trained its

own workmen. Under our factory system this method has been largely abandoned and nothing has been developed to take its place. Is it not the duty of the factory to develop a substitute for a system its methods have made obsolete? Is not the system of having a first-class workman study mechanical operations in detail and teach the younger man to perform them in the best manner he can devise, and at the best speed he can show, far superior to the old method where the apprentice might have an efficient teacher, but more often did not?

Surely nobody will deny that such a system is to be preferred to the old apprentice system, and, if so, the only question that arises, is, will it pay the manufacturer?

Inasmuch as the efficient workman often does two or three times as much as the poor workman, and always does it better, and inasmuch as the workman who does twice as much work cuts the general expense per unit of output in half, there would seem to be no question that such a system of training would pay handsomely. This will be discussed in detail in the subsequent chapters.

INDUSTRIAL APPLICATIONS OF REINFORCED CONCRETE.

By M. M. Sloan.

Mr. Sloan's review began in January with an argument of the peculiar adaptability of reinforced concrete to industrial structures, and a statement of some of the principal elements of design. In the second part, published last month, he took up structural details of floor, lintel, roof, and skylight design. He continues this discussion in this month's pages, and will conclude next month by a presentation of applications of reinforced concrete to equipment, foundations, reservoirs, and other of the less ordinary uses for which it may be employed.—THE EDITORS.

WHERE a reinforced-concrete building is constructed with a brick veneer, the reinforced-concrete skeleton frame is first built and the brick veneer laid after the frame is finished.

This type of construction is well illustrated in Figure 14, which shows clearly the reinforced-concrete skeleton frame, with the brick veneer partially completed. The brick veneer usually consists of one thickness of brick, and this is tied into the concrete work by means of copper or galvanized iron ties. For tying in the brickwork small galvanized-iron wire ties are sometimes used, while in the better class of work a copper ribbon about ¾-inch wide is allowed to project from the concrete and serve as a tie for the brick facing. When these ties are used they are generally tacked to the form boards in such a manner that about 4 inches of the tie will be imbedded in the concrete work. When the forms are removed a portion of the tie lying flat against the forms is bent out to receive the brick joint. Such ties should be provided for about every four square feet of wall surface. Figure 15 illustrates the usual method of tying in the face brickwork of a reinforced-concrete building.

That reinforced-concrete construction can be adapted to all the requirements of mills and factories, and can be used to replace any feature built in slow-burning construction, is shown in its application to the forming of saw-tooth skylights.

The saw-tooth skylight has been used extensively to provide lighting facilities in one-story mill buildings of large area, where it is desirable to have a uniform daylight illumination over the entire floor space. These saw-tooth skylights are usually arranged so as to pro-

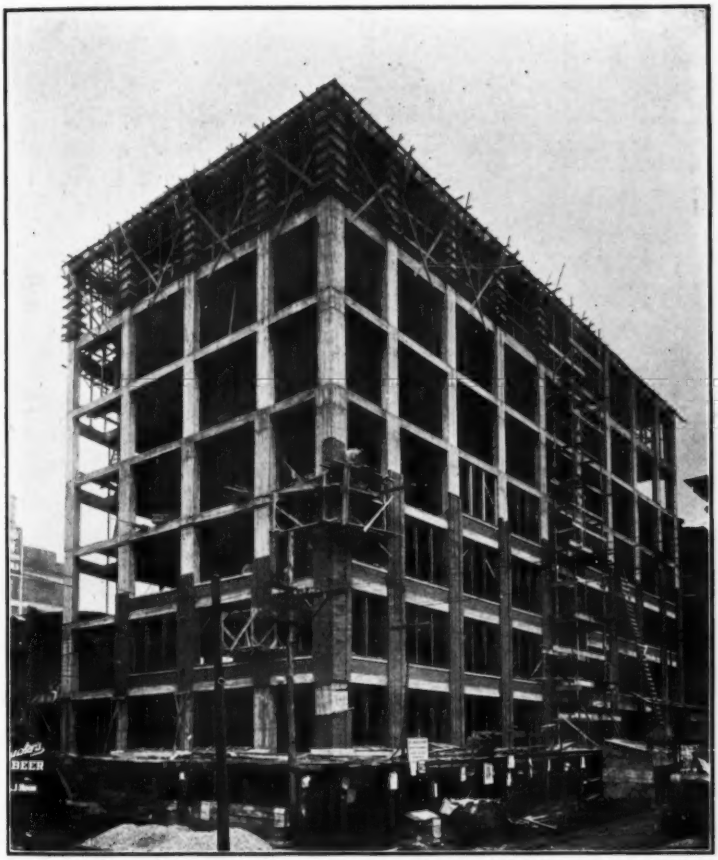


FIG. 14. REINFORCED-CONCRETE SKELETON FRAME BUILDING WITH BRICK VENEER PARTLY COMPLETED.

vide a north light, and thus prevent the direct penetration of the sun's rays, which are undesirable as illumination and on account of the heat in mild weather or summer time.

A typical saw-tooth skylight construction of reinforced concrete is shown in Figure 16, and while it is sometimes troublesome to build, it is entirely practical, and much used in factory construction. It consists of a sloping roof, carried on beams which are supported by oblique reinforced-concrete uprights. Sometimes horizontal tie-beams

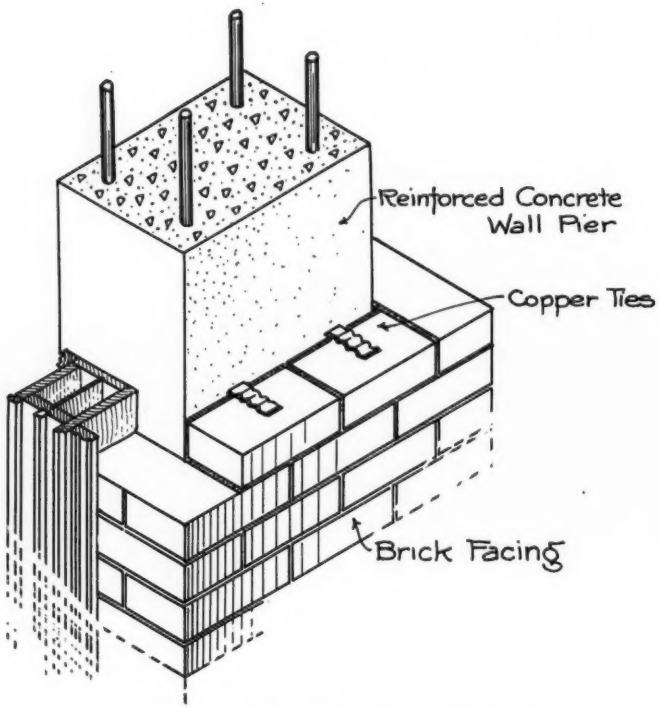


FIG. 15. METHOD OF TYING IN FACE BRICK WORK.

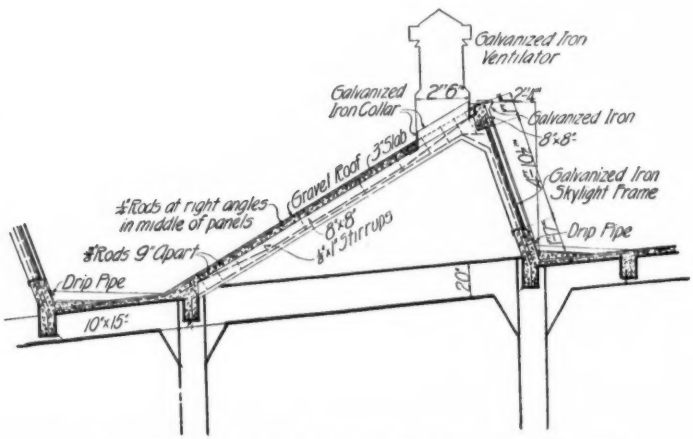


FIG. 16. REINFORCED-CONCRETE SAW-TOOTH SKYLIGHT CONSTRUCTION.

of concrete are provided in order to tie in the building, and for the possible support of shafting or other installations.

When of reinforced-concrete, the saw-tooth skylight is usually glazed with wire glass, held in metallic frames, so that the entire construction is fire-protective and fire-proof.

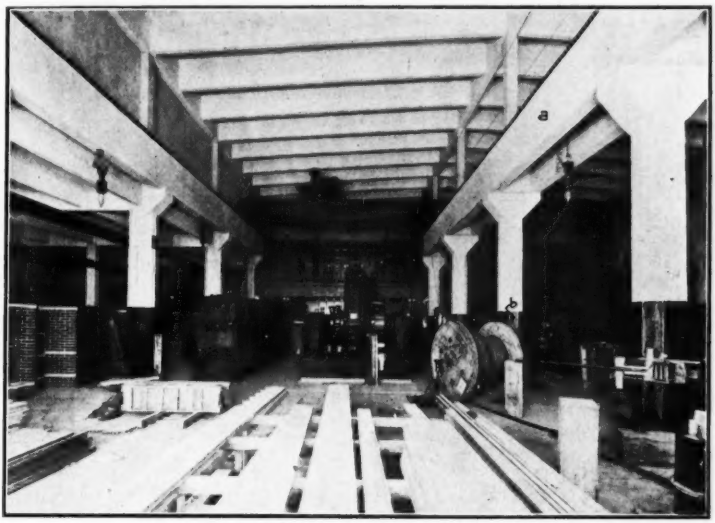


FIG. 17. REINFORCED-CONCRETE POWER HOUSE.

One of the best uses to which reinforced-concrete construction can be put is the construction of power houses. A good example of the use of this material for the purpose is illustrated in Figure 17. As usual in all power houses where large electrical generating units are installed, it is necessary to have a traveling crane; and the run-ways for these cranes are illustrated in the figure at "a." As the beams or girders carrying the track are rectangular in section, they must necessarily be very deep, especially if the crane load is heavy. Another feature of the illustration is the octagonal columns with the sheet-iron protection around the bases as illustrated at "b."

An excellent type of a one-story and gallery reinforced-concrete building, such as could be used for a machine shop or similar purpose, is shown in Figure 18. This cut illustrates a typical section of such a building and shows the method of lighting and ventilating the building by means of a lantern with continuous pivoted sash along the

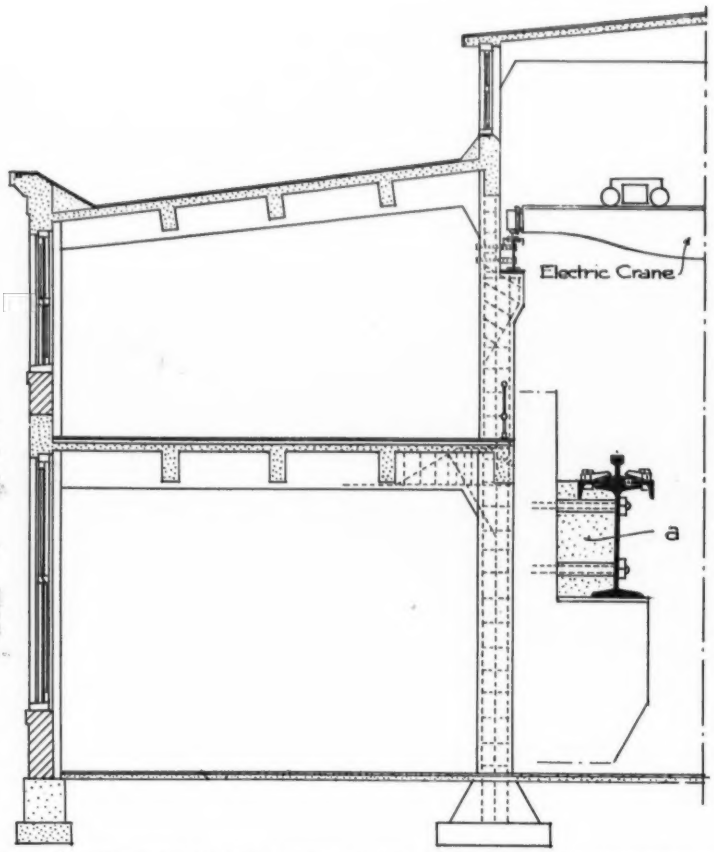


FIG. 18. REINFORCED-CONCRETE BUILDING WITH GALLERY, SHOWING CONSTRUCTION FOR SUPPORTING TRAVELING CRANE.

sides. The crane in this instance is carried on a steel I-beam, which is made secure against lateral deflection by means of a rolled steel channel, riveted to the top flange, and the girder is further secured to the reinforced-concrete column by through bolts and separators filled in with concrete as illustrated at "a."

The reinforcement of the column must necessarily be carefully studied to take care of the shear on the projecting bracket and to provide for the eccentric load on the concrete column.

This type of building may be constructed with reinforced-concrete wall piers and brick spandrel walls with large triple windows between the reinforced-concrete columns or wall piers.

The gallery is usually designed for floor loads from 150 to 200 pounds and is generally employed for the lighter machine work, such as lathes, shapers, and milling machines.

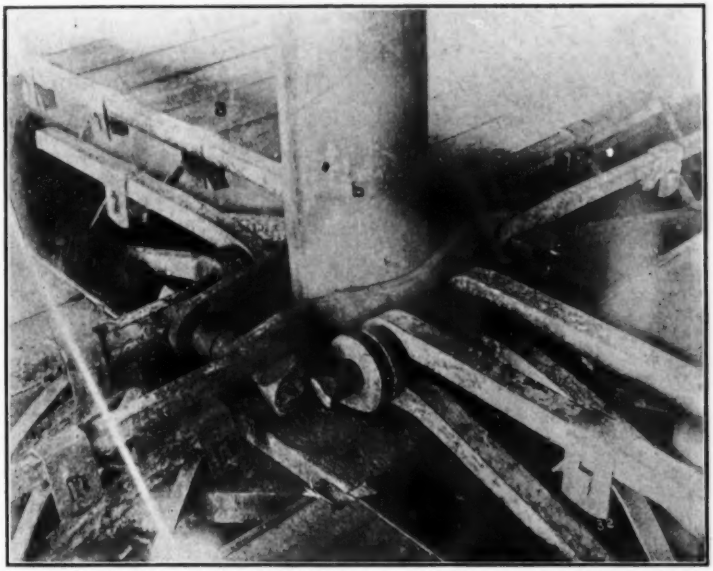


FIG. 19. DETAILS OF CAST-IRON COLUMN CONNECTION IN REINFORCED-CONCRETE FLOOR.

The necessity frequently arises for a building which, while not necessarily fireproof, is proof against ignition. Such a type of building would be used when the contents were not inflammable or ignitable, such as in metal-working shops, machine shops and foundries. There is no objection in buildings of this type to the use of exposed cast-iron columns, unless municipal regulations prohibit their use. It has been found advantageous to use this type of construction in those buildings where concrete columns would be too large and occupy too much floor space, and where they would be damaged on the corners by trucks, castings, or loads on swinging cranes, striking the concrete and spalling the corners.

A detail showing a cast-iron column connection used in conjunction with a reinforced-concrete floor system is illustrated in Figure 19. At "a" in the figure is shown the centering, in place to receive

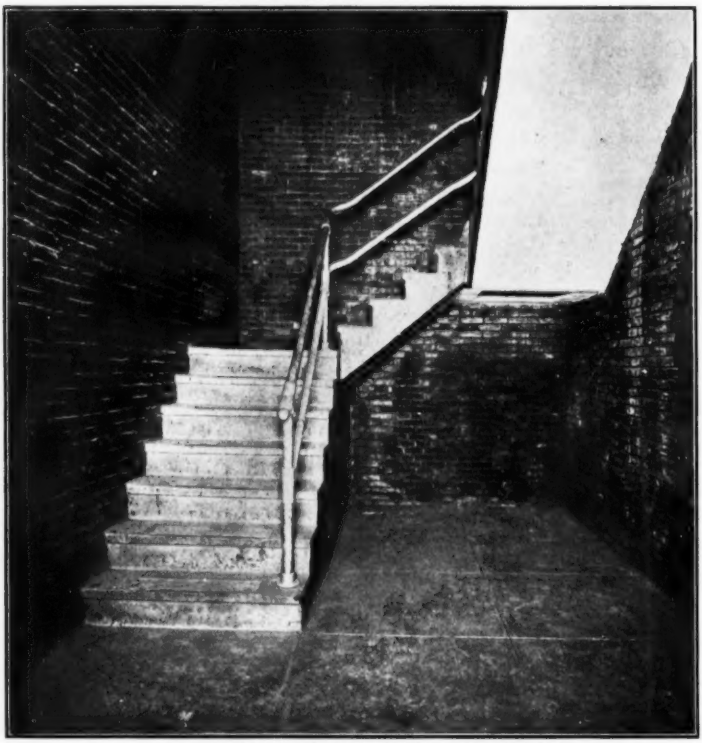


FIG. 20. REINFORCED-CONCRETE FACTORY STAIRWAY.

the concrete; while at "b" is illustrated the cost-iron column of an upper floor, and at "c" the connecting yokes tying in the pin-connected girder frame are shown in position. Such a type of construction and reinforcement gives great rigidity to the building, but cannot be classed as the best type of fireproof construction on account of the exposed cast-iron columns.

Regarding the resistance of cast-iron columns to the damaging effects of fire, however, it might be well to state that they are not as defective in this respect as is popularly supposed. The old story of cast-iron columns becoming red hot in a conflagration and then breaking to pieces in a stream of water from a fire hose, is not substantiated by the observation of facts, as they have existed after fires in which such columns have been exposed. There is probably no more durable

structural member of metal than a cast-iron column; so that for the type of building previously described they might be used to advantage, and they are especially adapted to the pin-connected type of girder-frame construction described in the illustration.

In the modern reinforced-concrete factory building effort is made to eliminate all wood work, and with care it is possible so to construct the building, when of reinforced concrete, as to do entirely without any wood or timber work in the entire building. This is accomplished by using reinforced columns and floor systems, with reinforced-concrete or brick walls, and by using in the window openings metallic window frames and sash usually glazed with wire glass. While it is the general practice to use the standard tin-lined door passed by the Underwriters (these doors consist of a wood core built up of flooring boards and tin-covered) it is not unusual to use, as a substitute for these, hollow metal doors, so that even the wood that was formerly used for the cores of the tin-lined doors can be omitted in the equipment of the building.

The stairways in such buildings are also generally constructed of reinforced concrete, though when they are enclosed in separate shafts, as used in brick-enclosed stairways or in tower fire escapes, they may be of wood if it is the purpose to reduce the cost of the building to a minimum.

The usual type of reinforced-concrete factory stairway is shown in Figure 20, and while generally crude and unfinished, they admirably answer the purpose for which they are intended. In this illustration it will be seen that the stairway is supplied with metal non-slipping treads embedded in the cement work, and that the rail of the stair construction is formed of galvanized-iron pipe put together with malleable-iron fittings and having the stanchions rigidly secured in sockets embedded in the concrete work. A very excellent way of constructing the steps in a concrete stair is illustrated in Figure 21. The form board for the riser is arranged as shown at "a"; it will be noticed that by beveling the top of the lower board and placing the upper form board on the outside, a projection in the rough concrete work is formed. The riser can then be finished by carefully flat spading the concrete work in the forms, or by putting on a slip-coat finish of cement mortar troweled and worked in. The tread is generally finished with a 1-inch or 1½-inch cement top finish, such as would be used to finish the top of cement pavements or floors.

Attention is called particularly to the adaptability of reinforced concrete to stair construction, for on account of the monolithic struc-

ture of the material, the stairs can be conveniently formed with quarter and half-pace landings; and each run of stairs can be so arranged with the adjoining runs as to form mutual support. It will be noticed from the illustration in Figure 21 that the stairs are not supported on any horses or beams; but the portion of the concrete between the intersection of the treads and risers and the soffit of the stairs acts as a reinforced-concrete slab. The reinforcement is carried down the stairs and across the platform so as to get a bearing on the brick walls of the stair shaft. It is not unusual practise to construct the reinforced-concrete stairs before any of the brick walls have been built, and to provide temporary wood supports or studs to hold the reinforced-concrete work in place until the brick masons have followed up with the brick walls.

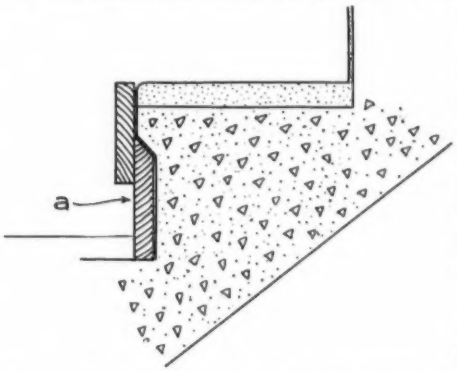


FIG. 21. REINFORCED-CONCRETE STAIR CONSTRUCTION.

Reinforced-concrete work has been extensively applied to the construction of various features in power-plant equipment work, of manufactories and industrial buildings. It has been used with success, and in fact makes the best foundation for heavy electrical generators, engines, and other power equipment, and it is invaluable in the construction of reservoirs and the water-supply installation. Besides, it has been used with success for large stacks and chimneys and in the construction of pipe tunnels and water ways. These features of the application of reinforced concrete to industrial plants will be considered in the next article.

WHAT MORE THAN WAGES?

By Kenneth Falconer.

The swinging pendulum of opinion as to so-called "welfare" institutions, to which Mr. Falconer refers below, has made several oscillations. The latest is away from the extremes to which some employers had gone. Mr. Falconer's review is of especial interest because it pursues no preconceived line, but undertakes a frank discovery of actual conditions in the mental attitude of the men as well as the employers.—THE EDITORS.

IN considering the present-day relations of workmen and employers, it is frequently asserted that modern conditions and the extent and scope of industrial organizations have made impracticable the personal and social relations which formerly existed—have relieved the employer of all responsibility for the material welfare and comfort of the workman except during those hours devoted directly to the employer's interests. It is claimed by many that the employer is best providing for his own interests and doing his full duty to his workmen if he lives up to the maxim, "a fair day's wage for a fair day's work."

In many branches of industry the pendulum is now swinging the other way; the very influences which have caused this modification in relations are now, in a broader measure than formerly, making the welfare of all dependent largely on social and living conditions the control of which lies in the employer's hands alone. Those responsible for the conduct of an ever-increasing number of large or medium-sized plants are directly responsible to their employees for very much more than "a fair day's wage" for "a fair day's work." It is getting more and more usual for large works to be established in, or to move to, rural communities or more or less isolated locations. In some instances (as for example pulp mills) the nature of the product, the supply of raw material, or the source of power, result in the creation of a town or community dependent in every detail of daily life on the operation of the works, and the decisions and actions of those in control of them. Under such conditions, self-interest if nothing else should make those on whom the success of the business depends consider what more than wages they will provide for their workmen; particularly in the case of educated and skilled mechanics, the content or discontent of themselves and their

families with their surroundings and general living conditions will have a direct and wide-spread effect on the vital question of a constant and permanent supply of labor. Less evidently, but just as certainly, it will affect the general efficiency of the various shops and departments.

In an article published in *Cassier's Magazine* in 1903 I said:

> That plans of industrial betterment have in individual cases resulted in benefit to both workman and employer cannot be questioned. That the good attained has been in direct proportion to their extent cannot be admitted, and neither their advocates nor their opponents will claim that they contain the elements of a straight business proposition between man and man. Up to a certain point proper conditions, surroundings, and even proper social opportunities are the workman's right,—a right which he is entitled to expect from those responsible for the conditions in which he may be working and living. When they pass that point they become simply gifts, and however tactfully given, or willingly received, their effect is rather to weaken than to strengthen the connection between the workman and the employer.

The suggestions and ideas which follow represent the result of personal study of factory town conditions, and to a greater extent of the expressed opinion of many representative workmen. By representative, I do not mean labor leaders or officials of labor organizations, but the ordinary skilled mechanic or unskilled workman, the former usually a more widely read, and the latter often a better educated man than many in more responsible positions. The workman of to-day does not want gifts or philanthropy; he claims as a right to which he is entitled, in addition to his wages, fair and decent living conditions for himself and those dependant on him. Whether or not such a claim is fair and reasonable depends on the meaning attached to the words. A consensus of many opinions would appear to result in the following composite definition:

> Opportunity to obtain the ordinary comforts and necessities of life at reasonable cost—facilities for giving children an education suitable to their station in life up to an age that they may leave home to complete it—possibilities of bringing up a family in surroundings sanitary and healthful from a mental and moral standpoint, as well as from a physical.

When an entire town, with all its attendant problems, is under the direct control of the company interested it should be definitely determined that all plans to provide for the material requirements of the residents must be self-supporting. At the same time they should not be regarded as profit-earning departments of the business, but the company should look for its return in the increased efficiency which will naturally result from satisfaction and content with their surroundings on the part of the men and their families. A practical method to determine what general conditions should prevail in the

town would be to consider the conditions existing in established towns from which the class of labor required would be likely to come.

The housing of employees is pre-eminently a matter to be considered with full regard to the special circumstances and conditions of each case, and to be provided for on the basis of earning sufficient revenue to cover costs of operating, without any element of gift on the part of the company. Somewhere between the often described model towns of large corporations like Cadbury's, or Lever Brothers, or that of the National Cash Register Co., and the old construction camps still used in some towns, or even the long rows of mill tenements familiar in connection with textile industries, will usually be found the "happy mean" for smaller works or more isolated towns. Below and on page 836 are shown types of houses built for employees of a pulp company in Canada. This is in a new town, the whole settlement being in its formative period. It will be seen that the workmen's houses are in pairs with ample space between each pair. In another part of the town detached four-room houses have been built to rent at from $4 to $5 per month, those shown being let at a slightly higher rate. A few more pretentious cottages (as shown in the lower picture) have been built, and are occupied at a higher rental by officials of the company. Given proper and sanitary conditions in the town and a supply of such houses always a little in excess of the demand, this company will have gone a long way towards solving the housing problem on a common-sense basis. As stated, this is a new town, and it will be interesting to watch how it works out, in view of its peculiar location. It is situated some 300 miles from the nearest

WORKMEN'S HOUSES IN A CANADIAN MANUFACTURING COMMUNITY.

COTTAGE FOR OFFICIALS OF COMPANY.

market or source of supplies, it has no rail connection, but is served during the summer by a more or less satisfactory steamship service, and it is practically isolated and thrown on its own resources for about four months each winter. Under these conditions it will readily be seen the company has no easy problem to determine just how far it is commercially practicable to improve the home surroundings of its workmen and their families, without on the one hand charging too much for rent, etc., or on the other introducing the element of gift into its relations with its employees.

Where the requirements of the manufacturing plant and the town together do not justify the installation of water and sewer systems, the substitutes to be provided should be very carefully thought out, and just as carefully watched in use. An ample supply of good water, taken from a source beyond the possibility of contamination, is a strong influence towards a healthy town. The particular method of obtaining it for the individual houses or families, whether from spring, pump, or hydrant, is not, and will not be regarded as, an important matter, so long as the water is good and the supply constant and plentiful.

The disposal of kitchen refuse and of sewage presents one of the most important problems in connection with a mill or factory town. If there are no sewers, the dump to which such refuse is hauled should be located in the first instance at such a distance that no future growth of the town can extend so as to make it either a nuisance or menace to health. Neglect and want of wisdom in such matters during the period of construction has resulted in many cases in conditions that might easily have been avoided when the town was built, but were very difficult to correct afterwards. Where sewage has to be cared for along these lines frequent service is of course an essential;—equally

frequent inspection at the houses, along the road traversed, and at the dump, will be equally essential if nuisances are to be avoided and the health of residents safeguraded as far as possible. It may be well, in deciding on a location in which to deposit refuse, to bear in mind the positive statement of many physicians of the highest standing that there is no more perfect agency in existence for the spread of typhoid and related diseases than the ordinary house-fly. From a recent scientific article I quote: "typhoid and many other infectious intestinal disorders peculiarly fatal to children can only be propagated as the feces of a sick person mingle with the food of, or reach the interior organs of, a well one." Constant, careful and systematic treatment of the dumping ground with the proper chemicals and disinfectants, (and also of the boxes, barrels, or other vessels used in the work) and close watch of the road between town and dump, so as not to create breeding places for flies, whether regarded as an operating expense of the town to be covered by its revenue or as a general expense of the business consequent on its peculiar location and surroundings, may be an economical insurance against an epidemic.

Where circumstances compel the company to maintain a general store without any competition, a factor is introduced that may easily cause friction and dissatisfaction to such an extent as to complicate greatly the question of getting and keeping a constant supply of suitable labor and of building up the town, and also to hamper the operation of the works. The best of superintendents is seriously handicapped by frequent and unexpected changes of men. Too often there has been some justification for the prevalent idea among workmen that a "Company Store" is largely a device to bring back to the company as much as possible of the money paid out in wages. In tho southwestern States some years ago it was repeatedly claimed by officials of the Knights of Labor, at that time a very powerful organization, that company stores were used to offset increases in wages which they had succeeded in obtaining for certain classes of workmen engaged in soft coal mines; that this was done by systematic and graded increase in prices very soon after the advance in wages was allowed. On the other hand, many workmen with whom I have discussed these matters and whose point of view I have tried to get recognize the expense and difficulty of operating such stores and admit the impossibility of doing so to the satisfaction of all. All kinds of solutions have been tried, from co-operation to fictitious competition (a remedy worse than the disease); but the real answer lies only in a spirit of fair play on both sides. The company should recognize that the chief function of its store is not to earn a profit, but rather

to satisfy, as nearly as possible, as many as possible of its customers without incurring a loss. A store that does this is usually of more value than one showing a considerable profit, but constituting a constant source of complaint and ill-feeling. To operate a company store to the best advantage, without any competition, particularly where at certain seasons the works are run on short time, but the men and their families still have to be provided for, calls for much more than ordinary store-keeping ability and experience. In such cases much can be done with care and tact to encourage the buying of the more nutritive and less costly foodstuffs by those who, left to their own devices, will use exactly the same articles on their table when the shops are running half time or less and a complete shut-down is imminent, as they are accustomed to when work is plentiful and labor in demand. If the slack season lasts long enough this course often leaves a number of families in debt to the company when full time is resumed, a condition unsatisfactory from any standpoint.

The prevailing market prices in more settled towns, special requirements due to climatic conditions or the nature of the work, the possibility or impossibility of individual families buying direct from outside sources of supply, and many other points besides cost should be considered when determining the price at which to sell staple foods and clothing and household necessities. Even if such goods only bring an advance on laid down cost sufficient to cover the expenses involved in handling them, it will be good business if the result is general satisfaction with the store on the part of the residents of the town.

Accepting for the present the definition of fair living conditions already quoted, the question of board obtainable by unmarried men should be given some consideration. Only to some degree will the law of supply and demand regulate this matter in a new town; but when the company has built boarding houses or an hotel, and leased them to outside parties, some supervision and some degree of control over the service rendered and the prices charged are apparently advisable. Simply to lease, and then leave the lessee to give as little as he can for as high rates as he can get, will often have a very sudden effect on the supply of available labor. Single men living in the same house in a mill town where outside attractions and interests are few get pretty close together, and attach a good deal of importance to what under other conditions would be regarded as trifles, and after grumbling individually are apt to act suddenly and collectively, and perhaps seriously embarrass some department or shop.

There is no one factor in operating a mill or factory town in an isolated location that has a greater and more direct bearing on living

conditions, and on the general welfare, than the permitting or prohibiting the sale of liquor, and regulating the sale and controlling the results if it is permitted. Not to allow the sale, and to prevent individuals absolutely from bringing it in for their private use, is practically impossible. Simply to rent premises to a saloon or hotel keeper the amount of whose revenue depends on the amount of his sales, giving him a free hand and keeping no control over his mthods of conducting the business, is demoralizing to the men, ruinous to the town, and directly against the firm's own interests.

The directors of many companies take the ground that they cannot interfere with men's freedom of choice in such a matter: that if there is a general demand for facilities to obtain such goods, the company must meet the demand exactly as they would if the residents of the town (or a considerable proportion of them) called for the store to carry a stock of books and magazines. While this argument may have some force it will be well to make sure that a demand for "wet goods" is genuine and as general as claimed. If ten men want a bar or saloon in the town they usually express and emphasize their desires more than twice that number who would prefer to see the town "dry;" this to say nothing of the wishes of the women and families, who are usually more deeply interested and directly affected than any others. Whatever the course of action decided upon, the company should retain power to lay down at any time such rules and regulations regarding the business as it may choose, and to modify or cancel at any time the permit to sell. The claim very general amongst workmen (and I think I am justified in saying universal amongst workingmen's wives) does not appear unfair or unreasonable: if in a town owned and controlled by itself, a company allows or permits the sale of intoxicating liquors, the duty of seeing that the result of such sale is not detrimental to the physical or mental comfort of residents lies with the company; if street fights are rife, and profanity and obscenity general, or if women are insulted or children frightened by drunken men, the officials of the company in charge are responsible, not the saloon keeper. In towns and cities the municipal authorities who issue licenses are responsible for the maintenance of order and decency.

In determining whether to remove to and remain in a new location workmen are usually, though sometimes unconsciously, largely influenced by the judgment and opinions of women members of their families or homes, who are more apt than the bread-winner to consider carefully, and attach importance to, some of the less material advan-

tages. As a result, the permanency of the supply of labor, particularly of skilled labor, is directly affected by the church and school facilities of the town. To these matters no general rule can be applied, as local conditions and requirements must be considered and provided for in each individual case. So far as school is concerned, it is safe to say that opportunity should be given to provide children with as good a common-school education as they would probably have received if brought up in settled towns, and at no greater cost; this quite irrespective of whether or not such a school can be made self-supporting. Some kind of connection should exist between the board of education of the Province, or State, and the management of the school; periodical inspection by official Government examiners will not only tend to keep up the efficiency of the school, but the fact of such inspection will go far towards giving present or prospective residents confidence that so far as the education of their children is concerned they will find proper conditions.

Provision for either physical or social recreation is a matter which should be largely left to the men themselves, with the assurance that any practicable plans will have the co-operation of the officials. Elaborate schemes devised and carried out by the officials of the company are not always appreciated as they deserve. A plot of land, drained, graded and levelled, for the playground; a football, two pairs of boxing gloves, a couple of base-ball gloves, together with half a dozen bats and balls, does not represent a very heavy outlay. Such an equipment provided by the company has in at least one instance been more appreciated, and used, than many more elaborate plans to provide recreation. As a general rule the active control and management of such schemes should be left in the hands of the men; any influence exerted by the manager or the other officials of the company, as such, should be in the nature of suggestion only; their active influence in any organization should be limited to their vote, which should have the same weight as that of any other member.

As already stated, this paper does not represent the personal and individual opinions of the writer only. On the other hand, they are not given as having the endorsation of any organization or class of workmen. They may, however, be taken as representing the result of considerable study at close range of the various problems of factory towns, and a sincere endeavor for a number of years to find out what is the real feeling of the average workmen regarding them, and to determine "what more than wages" is fairly due to workmen, and commercially practicable for the employer to provide.

THE DEVELOPMENT OF THE HYDRAULIC REACTION TURBINE IN AMERICA.

By H. Birchard Taylor.

Mr. Taylor's connection with the work defined by the title of his paper makes any contribution from him a classic in the literature of the subject. His attention here is devoted chiefly to results. We hope later to present his review of some of the most important studies by which these achievements were made possible.—THE EDITORS.

PREVIOUS to the construction of the turbine wheels for the first great hydro-electric installations at Niagara Falls, the typical American turbine was made from stock patterns and listed after the manner of high-speed steam engines. Catalogues and price lists were published by the various manufacturers, giving the powers, speeds and prices of the runners for operation under various conditions of head.

This development was the outgrowth of a vast number of tests on runners of various sizes and shapes, having all conceivable combinations of inflow areas, discharge areas and vane curvatures. A runner would be built on the inspiration of a designer and tested in a testing flume and, as might be expected, the results sought after were rarely obtained. The patterns for this runner would then be changed in certain parts and the test repeated. This process was continued until the runner was brought up to a high standard of efficiency. This method has been commonly termed the "cut and try" method.

The competitive tests made at the Holyoke flume did much to bring out the relative merits of the various styles of runners developed by many manufacturers. During the years 1879 and 1880, many tests were made at the expense of the Holyoke Water Power Company, for the sole purpose of investigating the claims made by the various manufacturers. The results of these tests were carefully tabulated and published for the use of those interested in hydraulic machinery.

As might have been expected, the Holyoke tests brought out many very odd and original designs, most of which gave evidence of little or no theoretical knowledge on the part of the designers. On the

other hand, some of the runners tested gave remarkably high efficiency and, consequently, reflected great credit on those who submitted them for test.

In Europe, the turbine developed along different lines. There it was the outcome of mathematical investigation and not experiment, and its evolution had been based largely on theory. In Europe one rarely found two turbines alike, for there it had been customary to design each machine for the actual conditions of power, head, and speed governing its installation. All questions directly or indirectly related to the theoretical laws which govern the passage of water through the turbine, had been most thoroughly studied in Switzerland and in Germany. For years machines had been built to order in these countries. Each of the various parts which go to make up the complete turbine had been made the object of the most careful investigation—the wheel casing, the guide vanes, the runner, and the draft tube; with the idea of increasing the efficiency of the unit as a whole by perfecting the various parts of which it is constructed.

On October 4, 1890, the Niagara Falls Power Company began work on a hydro-electric generating station which was to exceed, in size and importance, any which up to that time had been constructed, either in the United States or in Europe. It was proposed to install 5,000 horse-power, vertical-shaft, reaction turbines, to operate under a head of 136 feet and to run at a speed of 250 revolutions per minute, each turbine to be directly connected to an electric generator. When it is considered that previous to that time there had never been constructed a turbine of a greater capacity than 1,000 horse power, one may readily appreciate the effect that the successful operation of a 5,000-horse-power unit would have on the design and construction of hydraulic turbines.

Little had been accomplished in America that would have direct bearing on the theoretical side of the designing of a direct-connected turbine to meet the requirements at Niagara Falls. European designers, however, had had considerable experience in the designing of hydraulic machinery for both high and low-head installations; consequently, when it came to the construction of the Niagara turbines, the Europeans were in a position to calculate the requirements of the design from known theories. As far as the mechanical features were concerned, they found that on account of the size of the apparatus, this phase of the work presented various difficulties along lines in which they were inexperienced.

In consideration of these facts, it was not surprising that the ac-

cepted designs were those of Faesch and Piccard, of Geneva, Switzerland. American firms were willing to guarantee the material and workmanship only, leaving the responsibility for the design with the Europeans. The contract for the hydraulic machinery was awarded on this basis.

The turbines comprising the first great installation were, therefore, of foreign design and American manufacture. Ten units of 5,000 horse power each were constructed by the I. P. Morris Company, of Philadelphia, Penna., for Power House No. 1, of the Niagara Falls Power Company.

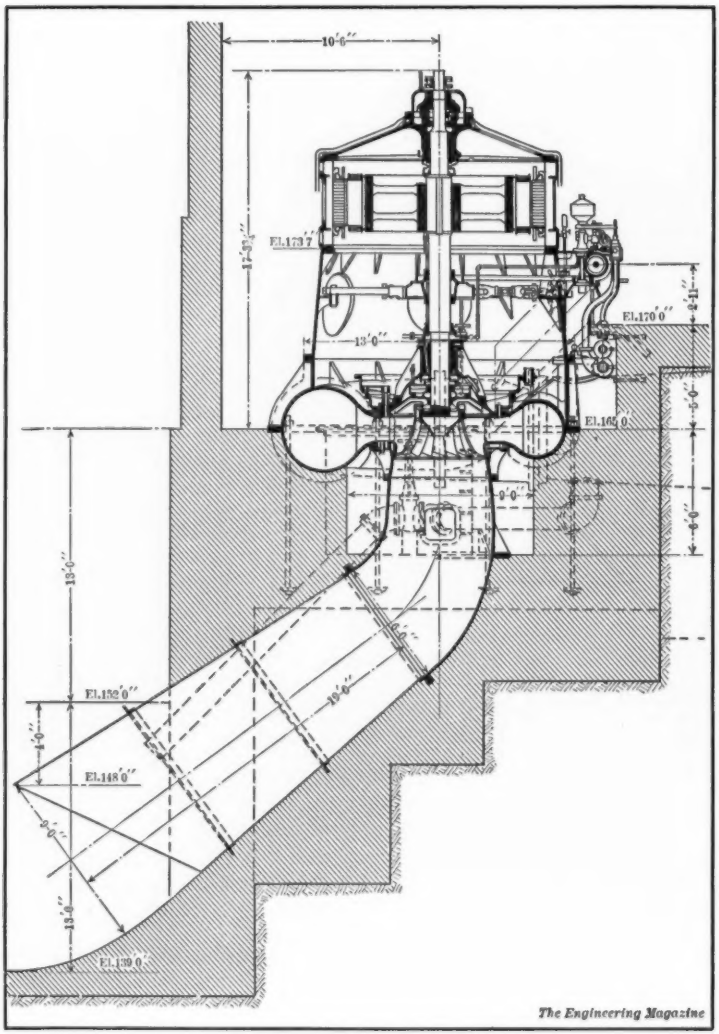
The eleven 5,500-horse-power turbines, which at a later date were installed in Power House No. 2, of the same company, were also constructed in Philadelphia, from the designs of Escher Wyss & Company, of Zurich, Switzerland. They are of the inward flow, Francis type.

Two of the 10,000 horse-power inward flow Francis turbines installed in the power house of the Canadian Niagara Power Company, were also constructed in Philadelphia from the designs of Escher Wyss & Company, the remaining units being built by the designers.

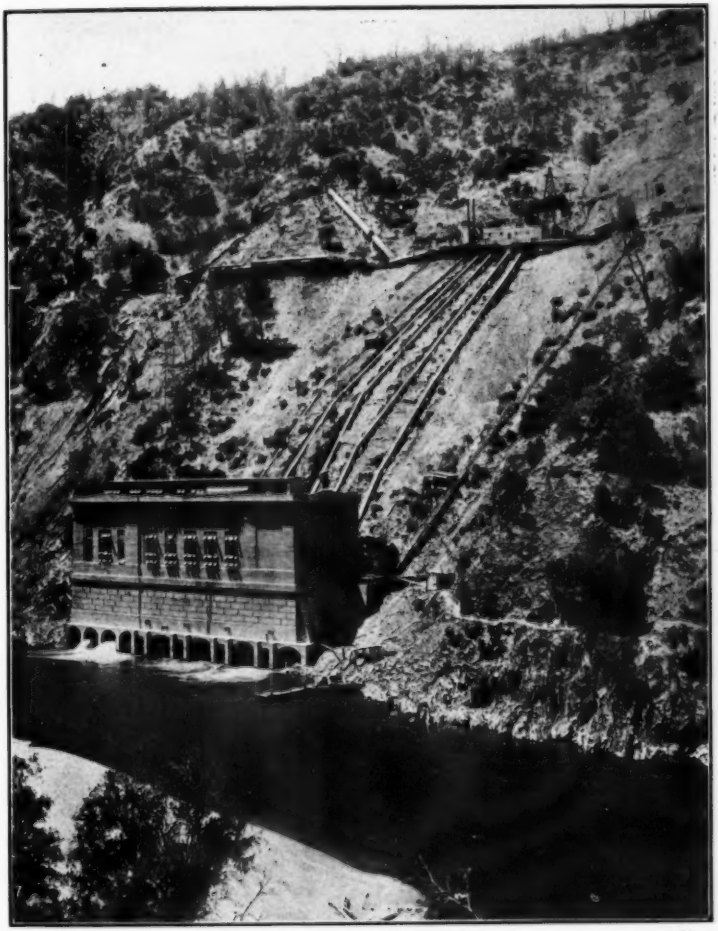
Not long after the installation of these turbines, a few concerns in the United States began the construction of high-power and high-head turbines for special conditions, from their own designs; the best examples being the four 2,000-horse-power Fourneyron, outward flow, reaction turbines, designed and built for the Utica Gas & Electric Company to operate under a head of 266 feet and to run at a speed of 360 revolutions per minute. Also two 6,000-horse-power inward-flow Francis turbines, designed and built for the Shawinigan Water & Power Company; head 125 feet, speed 180 revolutions per minute. These units have recently been converted into 9,000-horse-power units by rebuilding their runners and distributors.

These installations marked the beginning of the new American school of design. This school was created by the demands of a new field, which called for first-class machinery beyond the capabilities of the American turbine as previously constructed.

As it is impossible to predetermine the speed that will give the highest efficiency with a projected runner built by the "cut and try" method, this class of machinery is practically useless for direct connection. Stock runners being used, the proper speed of the driven machinery is obtained by the use of gearing, which is not only inefficient, but cannot be used with high powers.

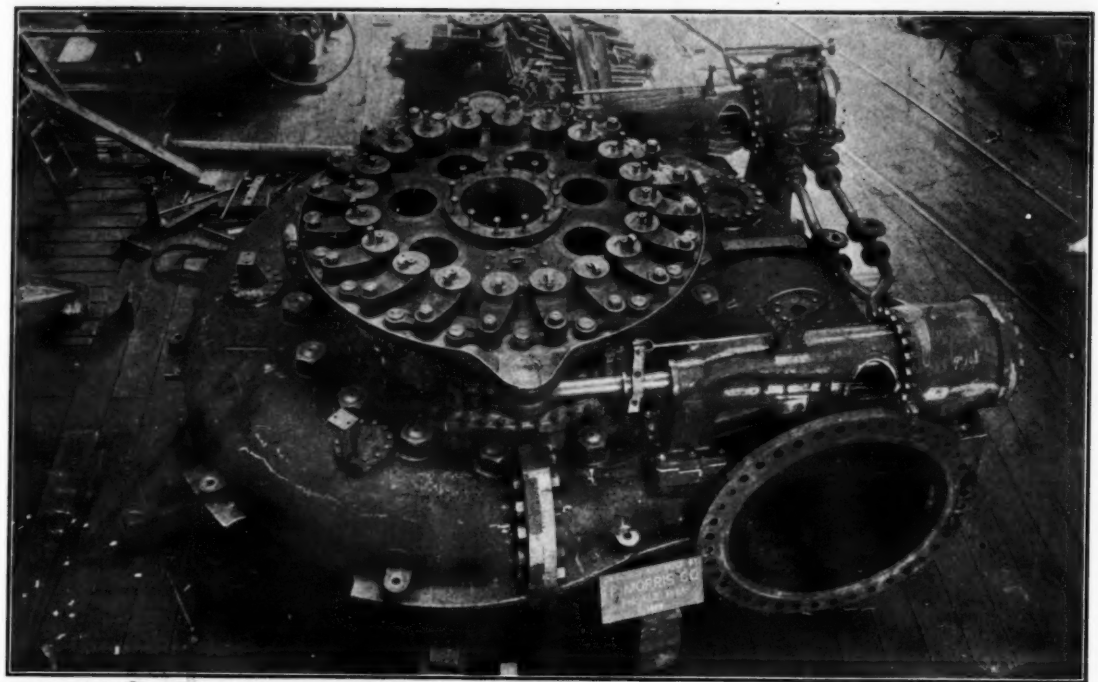


SECTIONAL ELEVATION, PELTON-FRANCIS 5,000 HORSE-POWER TURBINE FOR SCHAGHTICOKE HYDRO-ELECTRIC PLANT.
Pelton Water Wheel Company. See page 861.



A MODERN AMERICAN PLANT. POWER HOUSE OF THE GREAT WESTERN POWER COMPANY, FEATHER RIVER, CALIFORNIA.
Courtesy of Viele, Blackwell & Buck.

The "cut and try" method of constructing turbines may be termed the old American school of design, if it may be rightly termed "designing;" and for the conditions for which they have been intended, wheels so constructed have given entire satisfaction. The market for this class of machinery is growing and, even in Europe, it is not



ONE OF THE 18,000 HORSE-POWER TURBINES FOR THE GREAT WESTERN POWER COMPANY'S FEATHER RIVER PLANT, IN COURSE OF ERECTION AT THE SHOPS OF THE I. P. MORRIS CO.

denied that the American engineers have achieved remarkable success through their practical qualities, and American methods have been copied there.

The principal requirements which resulted in the creation of the new American school of design, are as follows:

1.—Turbines must be directly connected; therefore, the speed and efficiency for any head and power must necessarily be predetermined. This requires that each turbine be specially designed and that the design be complete before any construction begins.

2.—As a turbine might cost anywhere from say $5,000 to $50,000, it cannot be built as an experiment.

3.—High efficiencies must be guaranteed and, in many cases, under a severe penalty for non-fulfillment.

4.—The material, workmanship, and the performance, in most cases, must be guaranteed by the builder for a stated length of time from the date when the wheel is placed in commercial operation.

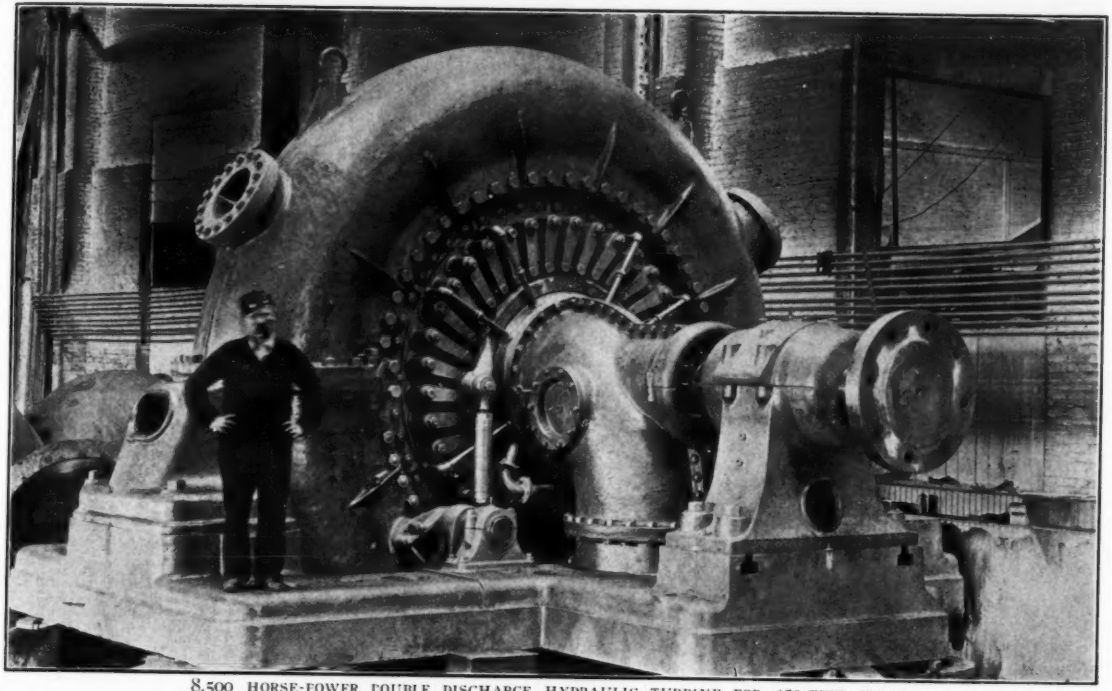
5.—The runners and guide vanes must be designed to withstand the severe conditions imposed by high heads, without erosion.

We may readily appreciate the fact that machinery constructed under the old school could not find application to these new requirements.

During the past six years, the progress made by the American engineers in the field of specially designed turbines has been truly remarkable.

Six years ago, a head of 300 feet was universally considered by engineers to be the upper limit to which the reaction type of turbine could be successfully applied; the impulse type of turbine having been used almost exclusively for heads exceeding 300 feet. This limitation in the field of application of the reaction turbine did not result from any theoretical difficulties encountered in the design of the turbine for higher heads than 300 feet, but it resulted from the fact that a very large percentage of the turbines operated under heads of over 150 feet were failures.

Today, we realize that the state of the art six years ago was not sufficiently advanced to enable the designers to cope successfully with the severe conditions imposed by heads of over 300 feet. At that time, however, it was thought that all the theoretical laws governing the flow of the water through the reaction turbine had been thoroughly mastered and that the failure to design successful machines for the high heads was a natural one, as all other prime movers are more or less limited in their fields of application. This view of the matter, al-



8,500 HORSE-POWER DOUBLE DISCHARGE HYDRAULIC TURBINE FOR 450-FEET HEAD.
Built by the Allis-Chalmers Co. for the Telluride Power Co.

though not backed by mathematical proofs, was generally accepted as a fact.

Today, a successful turbine not only means one in which the efficiency is high and the turbine as a machine gives first-class operation mechanically, but it also means that the guide vanes and wheel vanes will not be destroyed by erosion.

In the development of the turbine, the last consideration has received as much attention as the question of obtaining very high efficiency—perhaps even more attention—and the failure of the reaction turbine to meet this condition successfully has been the limiting feature in its application to high heads.

The higher the head for which a turbine is designed, the higher the velocities will be through the runner. Therefore, the higher the head, the more severe are the conditions imposed upon the runner, and it necessarily follows that the higher the head, the nearer the hydraulic design must approach to perfection, in order to insure lasting qualities.

For a head in the neighborhood of 25 feet, a runner may be installed which has not been properly designed for the conditions of power, head, and speed for which it was intended, and yet it may last for years, the hydraulic conditions not being severe enough to destroy it. For high heads, a runner might have a very high efficiency, say for example, 85 per cent, but the runner might last for only a month or two before the vanes have eroded to such an extent that it must be replaced.

One would naturally suppose that 85 per cent efficiency is an indication that the water is passing through the turbine about as it should, and that, consequently, there is little or no danger of erosion developing. Unfortunately, the high efficiency is not an absolute guarantee of non-erosion. In the case of high-head turbines, a slight change in the design may mean the difference between erosion and non-erosion, and at the same time the change in design may not be detected in an efficiency test.

Within the last few years it has been clearly demonstrated that erosion is a result of defective design. The elimination of erosion by proper designing has broadened the field of application of the reaction turbine to the higher heads, to which it had previously been the custom to apply the impulse type of turbine only. In times past, erosion has been attributed to a number of causes, and I believe that a short review of this subject would be of interest to the reader.

From time to time the following causes have been thought to bring about erosion:

1.—Foreign substances in the water.
2.—Poor material.
3.—Electrolysis.
4.—Chemical action.
5.—Defective design.

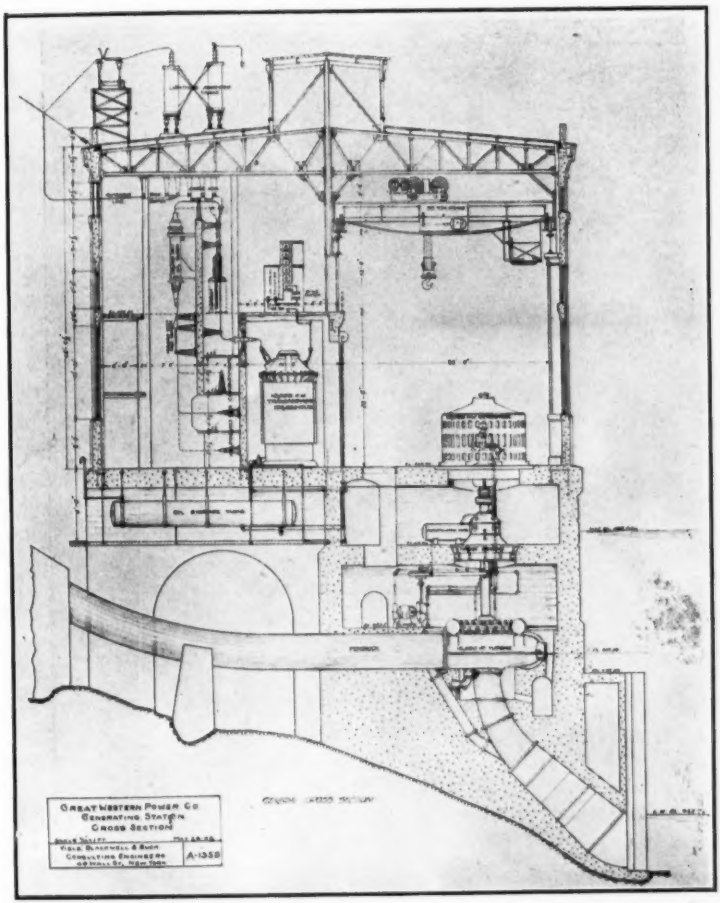
Foreign substances in the water will cause mechanical abrasion of the runner vanes, but this action is not in any way connected with the erosion which results from defective design. The impact of cutting particles against the surface of the vanes acts exactly as a sand blast, and the particles of sand and grit cut away the material of the sections of the vanes which receive more or less directly the impact of the entering water. The surfaces so acted upon first have the appearance of having been polished, but in time the metal will cut away below the surface of the adjacent metal. The surfaces cut away are smooth and do not contain the pitted marks which result from erosion.

The clearances at the seals between the runner and stationary parts of a turbine are increased at an accelerated rate by foreign substances in the water, until the leakage at these points becomes so great that it is necessary to replace the worn parts. Recently it has become customary to equip the turbines with removable rings at the seals, so that these parts may take the wear and from time to time be replaced at small expense and without permanent damage to the turbine.

The writer is familiar with a case where a bronze runner, under a head of 266 feet, was so eroded at the end of a few months' operation that it was necessary to replace it. The new runner, which was of a slightly different design, operated for five years without showing any signs of wear. Here we have a case where two runners were installed in the same turbine and operated by the same water. The destruction of the first runner could not be charged to foreign substances carried by the water, as the second runner was not affected.

In another case, there were two installations of turbines on the same stream and quite close to each other. The runners of the turbines in one installation were soon destroyed by erosion, while the runners of the turbines in the second installation operated for years without showing any signs of erosion.

As a proof that erosion is not primarily due to the kind of material used, let us again refer to the two runners which were operated under the head of 266 feet. The material in the second runner, which did not erode, was of exactly the same chemical composition as the first runner, which eroded; both castings being made of a special bronze.



SECTIONAL ELEVATION OF GREAT WESTERN POWER COMPANY'S FEATHER RIVER PLANT.
I. P. Morris turbines, General Electric alternators.
Courtesy of Viele, Blackwell & Buck.

Experience has shown that some materials resist erosion better than others. Bronze is the best metal, cast steel a close second, while runners of cast iron are the most susceptible. No metal, however, is proof against erosion if the design of the runner is such as to cause it.

The four 18,000-horse-power turbines of the Great Western Power Company are equipped with runners of different metals. Two of the runners are made of special bronze, one of cast steel, and one of cast

POWER PLANT OF THE GREAT WESTERN POWER COMPANY, FEATHER RIVER, CALIFORNIA.

The four 10,000-kilowatt three-phase 60-cycle General Electric alternators are direct-connected to 18,000 horse-power Francis turbines below, as shown on page 851. The exciter in the foreground is driven by an impulse wheel. All hydraulic machinery by the I. P. Morris Co. Photograph furnished by courtesy of Messrs. Vicle. Blackwell & Buck.

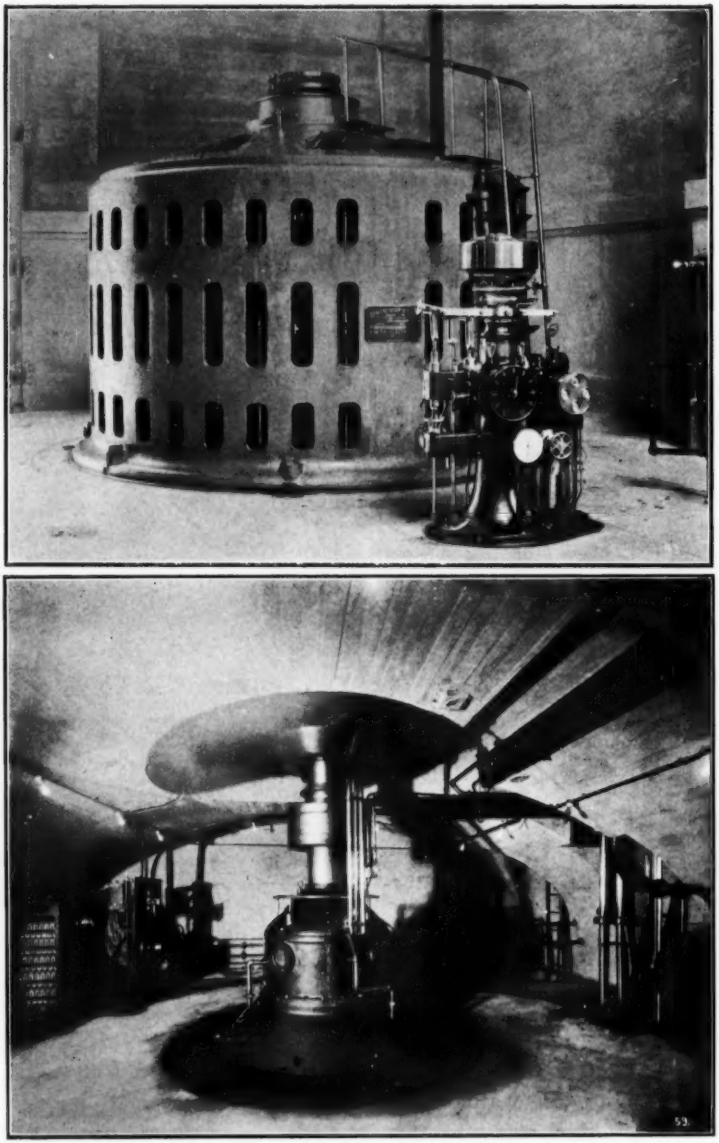
iron. The first turbine was started in operation in December, 1908, and all the runners have been in operation long enough to show signs of erosion, if the design were defective. Up to the present time no signs of serious erosion have appeared. The present operating head under which these runners work is 420 feet, and is the highest head to which a cast-iron runner has been applied. In consideration of the fact that cast-iron runners have been known to erode under a head as low as 30 feet, the successful operation of the Great Western runners has been exceedingly gratifying to the designers of these machines.

Those who believe that erosion results from electrolysis have considerable evidence to back up their views.

The writer is familiar with a case in which runners, under a head of 30 feet, were badly eroded after only a few months of operation. The engineers of the plant in which these runners operated conceived the idea that the erosion was due to electrolysis. It was thought that a current of electricity was passing from the tracks of an electric railroad, which passed in close proximity to the power house, into the stream and from the stream to the turbine and generator which delivered the power to the railroad. The engineers, endeavoring to locate the current, connected a galvanometer to a coil of wire connected to the turbine shaft. No indication of a current was found and the engineers dropped the theory of electrolysis and decided that the trouble resulted from a chemical action.

Some recent investigations carried on in Europe developed the fact that, in cases where erosion occurred, the metal eaten away from one section of a vane was deposited in the form of a lump at another section. This action would certainly indicate the presence of electrolysis. As electrolysis usually accompanies a chemical action, it was assumed that it was a secondary effect and that the chemical action was the primary cause of the trouble.

The theory based on chemical action was then thoroughly studied, with the following results. It was found that the eroded surface consisted chiefly of oxides and that it was the convex side of the vane which was usually affected, and not the concave side. In other words, the erosion of the vanes occurred at the sections where there was a likelihood of the water leaving the surface of the vane. As the oxygen necessarily came from the water, it was assumed that it was liberated as the pressure of the water was suddenly reduced as it passed into the runner. The oxygen was thought to be liberated, largely in the nascent state, into the voids caused by the water leaving the surface of the vane. It was argued that the oxygen rapidly attacked the clean



ABOVE, ALTERNATOR AND GOVERNOR; BELOW, THRUST BEARING AND CONNECTION TO TURBINE BELOW MAIN FLOOR, GREAT WESTERN POWER COMPANY.
Courtesy of Viele, Blackwell & Buck.

metal surface, forming an oxide coating which in time was rapidly washed away from the surface when the position of the turbine gates was changed; this process being repeated until the surface of the vane became pitted. The pitting offered more surface to the oxygen and, consequently, the erosion increased at an accelerated rate, until the vane was entirely eaten away.

The presence of gases in streams under high pressure has been thoroughly investigated by the manufacturers of the impulse turbine. In experimenting with a stream discharged into the atmosphere from a nozzle, under high pressure, it was found that at the instant the stream left the nozzle it was perfectly clear; an instant later, or at about two diameters from the point of issue, a slight enlargement of the stream was noted. This enlargement was attributed to the imprisoned gas freeing itself on the relief of pressure. This disengaging process was found to continue for a distance of about fifteen diameters, after which the stream begins to clear up.

Surrounding the jet for the distance in which the gases were being liberated was a fog, or "water dust," showing clearly the disengagement of imprisoned gas. Undoubtedly, this condition occurs in the reaction turbine after the reduction of the pressure of the entering water.

The whole question of erosion boils down to one of design. Design the wheel vanes properly, prevent the chemical action, and eliminate the electrolysis.

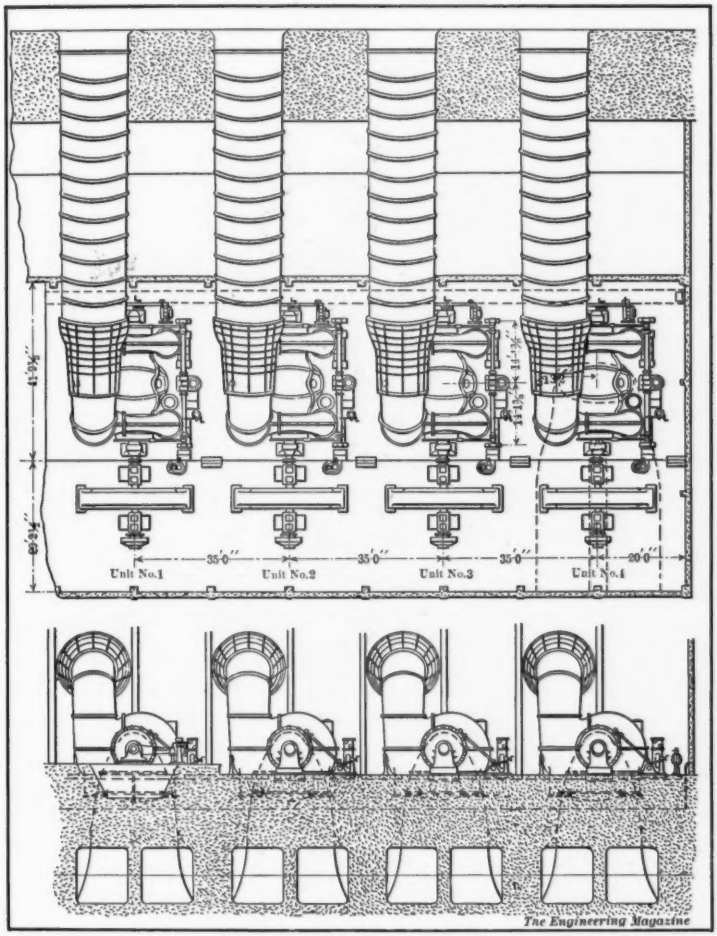
Today, the American designers are in a position to design and construct first-class machinery to meet the most severe requirements. They have to their credit the largest turbines in the world, among which might be mentioned:

Four 13,000-horse-power, two-runner Francis turbines, now operating in the plant of the Toronto Power Company, at Niagara Falls. Head 133 feet, speed 250 revolutions per minute, quantity of water required per turbine, 1,060 cubic feet per second.

Four 9,000-horse-power, two-runner Francis turbines, now being installed in the Little Falls plant of the Washington Water Power Company. Head 66 feet, speed 150 revolutions per minute, quantity of water required per turbine, 1,500 cubic feet per second.

Five 13,500-horse-power, two-runner Francis turbines, now being installed in the power house of the McCall Ferry Power Company, on the Susquehanna River. Head 53 feet, speed 94 revolutions per minute, quantity of water required per turbine, 2,800 cubic feet per second.

HIGH-PRESSURE FRANCIS TURBINE 13,000 HORSE POWER, FOR 380-FEET FALL.
Built for Great Northern Power Co., Duluth, by the Allis-Chalmers Co.



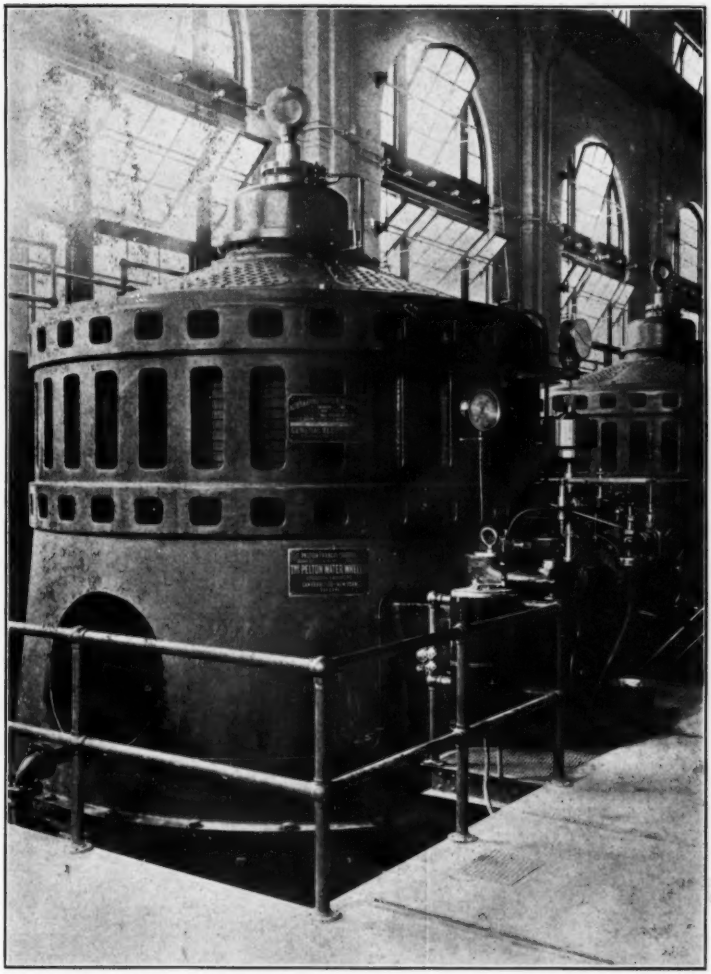
POWER-HOUSE ARRANGEMENT, 9,000 HORSE-POWER TURBINES FOR THE WASHINGTON WATER POWER COMPANY.

General plan. Installation by the I. P. Morris Co. See page 855.

All of these turbines were constructed by American builders from their own designs. American designers have also to their credit the highest powered turbines in the world, i. e.,

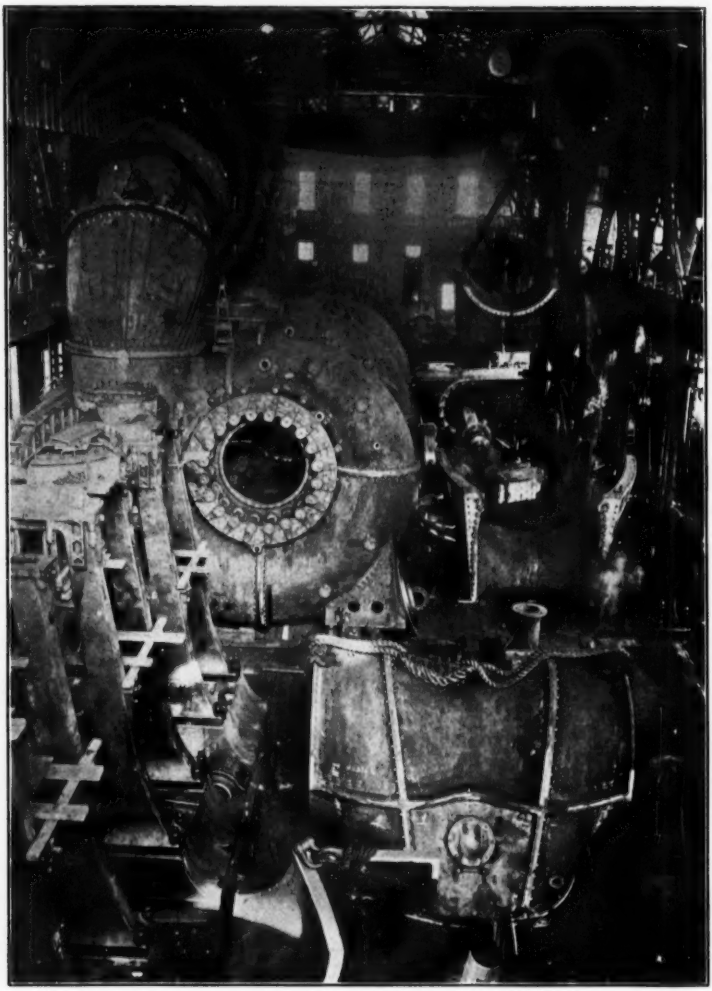
Four 18,000-horse-power, single-runner Francis turbines, now operating in the power house of the Great Western Power Company,

9,700 HORSE-POWER HYDRAULIC TURBINE, 550-FEET HEAD.
Built for California Gas & Electric Corporation by the Allis-Chalmers Co.



ONE OF THE 5,000 HORSE POWER UNITS INSTALLED BY THE PELTON WATER WHEEL COMPANY FOR THE SCHAGHTICOKE PLANT OF THE SCHENECTADY POWER COMPANY.

on the Feather River, at Oroville, California. Ultimate head, 525 feet, speed 400 revolutions per minute. When operated at wide open gate, under 525 feet head, each turbine is capable of developing 20,000 mechanical horse-power. These turbines were designed and built by the I. P. Morris Company.



THE 9,000 HORSE-POWER TURBINES FOR THE WASHINGTON WATER POWER COMPANY.
By the I. P. Morris Co.

The American designers have also to their credit reaction turbines applied to higher heads than has ever before been attempted.

The 13,500-horse-power, single-runner turbines, designed and built by the Allis-Chalmers Company for the Great Northern Power Company at Duluth, Minnesota, are operating under a head of 365 feet and at a speed of 375 revolutions per minute.

The 9,700-horse-power, single-runner Francis turbine, designed and built by the same company for the California Gas & Electric Corporation, operates under a head of 550 feet and at a speed of 400 revolutions per minute.

In this class may be included the 18,000-horse-power units of the Great Western Power Company, designed for a head of 525 feet.

The I. P. Morris Company is now constructing two 6,000-horse-power, single-runner Francis turbines for the Noriega development in Mexico of the Michoacan Power Company. These units will operate under a head of 670 feet and will run at a speed of 514 revolutions per minute. This head is the highest to which the reaction type of turbine has ever been applied.

The efficiencies obtained from the highest class of apparatus designed in the United States equal, if not exceed, the best results obtained abroad.

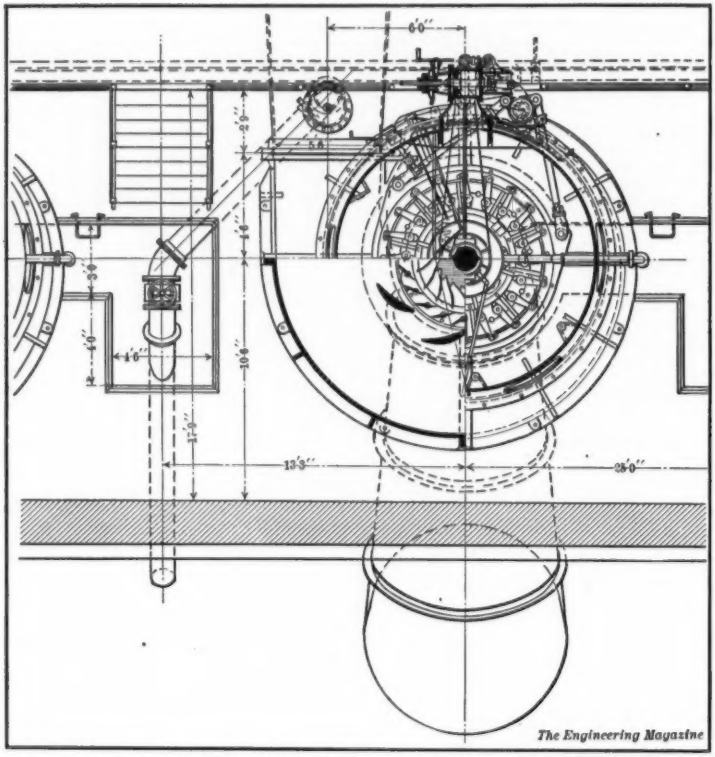
The average maximum efficiency of the four 18,000-horse-power units of the Great Western Power Company was found to be 88 per cent.

The maximum efficiency of the 10,500-horse-power Francis turbines designed by the I. P. Morris Company for the Shawinigan Water & Power Company, Shawinigan Falls, P. Q., Canada, was found to be 87.3 per cent.

The maximum efficiency of the 9,700-horse-power Francis turbine designed by the Allis-Chalmers Company, for the California Gas & Electric Corporation, was found to be 85.5 per cent.

The average maximum efficiency of two of the four 5,000-horse-power Francis turbines designed by the Pelton Water Wheel Company for the Schenectady Power Company, was found to be 85.7 per cent.

The average efficiency at normal power of three of the seven 10,000-horse-power turbines designed and built by the I. P. Morris Company for the Niagara Falls Hydraulic Power & Manufacturing Company, was found to be 90.3 per cent. The maximum efficiency of one of the units was found to be 91.7 per cent, at 8,934 horse-power. These wheels are, without doubt, the most efficient in operation today.



PLAN OF 5,000 HORSE POWER VERTICAL SHAFT PELTON-FRANCIS TURBINE FOR THE SCHAGHTICOKE PLANT, SCHENECTADY POWER COMPANY.
Pelton Water Wheel Co. See page 861.

The maximum efficiency of the four 750-horse-power turbines designed by the same concern for the Porto Rico Light & Power Company was found to be 90.3 per cent.

All of these installations are representative of the highest type of American design and manufacture.

ORGANISATION BY PRODUCTION FACTORS.

By A. Hamilton Church.

VI. CONTROL ACCOUNTS.

In the first article of the series, which appeared in our October issue, the author defined his purpose. It is to avoid the uncertainties and errors of averaging and apportioning a general expense account, by recognizing from the outset all the important factors in production—many of them, in his view, quite as distinct and determinable as the wages factor—and reducing them to unit values which can be directly applied to the product they serve. The first paper was devoted to "The Definition of Factors other than Labour," the second to "Production Factors as Related to Cost Accounts and Staff," the third to "The Elements of the Land Factor," the fourth to "Buildings, Heating and Ventilation, Stores, and Organisation" and the fifth to "Apportioning Indirect Expense by Production Factors." —THE EDITORS.

A BRIEF review of the arrangements hitherto outlined will serve as an introduction to the subject of control.

The separation of the different items of indirect manufacturing expense into regular annual rents or payments for specific services was the first step. These annual rents when related to some basis of distribution, such as a square foot of floor space or an horse-power hour, are termed production factors. Secondly, these annual rents or charges are apportioned amongst the various machines or production centres, and to them are added certain factors individual to each machine, such as depreciation, repairs, etc. The aggregate of the charges found to be incident on each machine is divided by the working hours of the machine, per annum, and the resultant is an hourly machine rate which represents the cost of all the indirect charges or services at the tool point.

But as all machines are not working all the time, and consequently all the burden is not got rid of through the various tool points, the device of a supplementary rate is employed to take up this undistributed burden, together with certain other items of waste and dead loss, so that the proportion of wasted capacity to the useful capacity of the shop can be ascertained, and, if desired, expressed as an element of cost.

This is the bare theoretical outline of organisation by production factors. The practical working demands, first, that a careful determination of the various indirect services or factors shall be made; and secondly, that adequate methods be adopted of securing that the

factor-values shall be in continuous correspondence with the actual conditions obtaining in the shops.

A system of accounts controlling the production factors and their relation to the machine rates and the supplementary rate is, therefore, an important feature of this method of organisation. Effectual control may be considered under four heads, viz:—

1.—A means of observing how far the variable elements of expense included in the factors (such as repairs) are keeping within the amounts forecast.

2.—A method of dealing with discrepancies as they arise.

3.—A simple means of ascertaining the amount of burden that has not been distributed at the tool point, and its relation to burden that has been so distributed.

4.—Mechanism for varying the machine rates when the normal working year of 2,700 hours (or whatever basis has been fixed) is exceeded, as for instance, when overtime is being regularly worked or when double-shift or night shift working has been adopted.

Variable Elements of Factors.

Every factor contains one or more elements of a variable character. Each for example, includes the use of perishable property and involves maintenance and repair charges that may not always be forecast with accuracy. All factors, being in the nature of rents charged for specific services, correspond to ordinary property rents in the respect that while the rent charged is a fixed annual sum, the outgoings or expenditures are not uniform at all times. The owner of a row of houses, for instance, does not pocket exactly the same amount of net revenue every month or every year, nevertheless the rent charged provides an average net revenue taking one year with another. This is precisely the principle on which production factors are based. The object to be attained is the fixing of factors on such a basis that, taking one financial period with another, they represent with fair accuracy what might be termed the "equalised" expenditure on each service.

This result will obviously not be attained immediately, nor without some experience of the variations that take place in expenditure. It is therefore important to provide some means whereby the actual expenditure on each separate service can be constantly observed and contrasted with the fixed factor that purports to represent it. There is no inherent impossibility in determining factors with great accuracy if the items of which they are made up are carefully and individually

considered, but even then provision must necessarily be made for making sure that they are accurate, however carefully and conscientiously the determination may have been made. This provision takes the form of shop ledger accounts for each service, and for each production centre.

Figure 1 gives the form of one of these controlling accounts. On the debit side are placed, first, the invariable items, such as interest, depreciation, land factors, and secondly, the *actual* expenditure on maintenance, repairs, and all other variable items, as it is incurred, month by month.

The account is credited with the amount of each element of the factor as fixed officially. The difference between the two sides, at the end of the financial period, or indeed at any time, will be the excess of actual charges over the estimated charges distributed by the factor, or *vice versa.*

The discrepancies between the amounts as distributed by the factors and the actual expenditure on the items that go to make up the details of such factors require individual attention in each case. They are not necessarily unexpected or unforeseen. On the contrary, the prinicple laid down involves the necessity for over-estimating in some instances and under-estimating in others, if a general or "equalised" level of expenditure is to be represented in the factors. Leaving intentional discrepancies for a moment, the question of unexpected discrepancies needs some attention, inasmuch as they may involve, on occasion, a modification of the factor.

If an unexpected discrepancy makes its appearance, one of two courses may be adopted; (1), the factor may be modified, at once, so as to absorb the amount of the discrepancy; or (2), the balance may be allowed to accumulate in the ledger account to the end of the financial period.

The former of these alternatives is obviously to be avoided if possible. It is necessary only if the discrepancy is a grave one—sufficient, if the factor were modified, to give rise to an alteration in the machine rates. It would, of course, be rare that a miscalculation in a single element of a production factor would be so large as in itself to affect the hourly machine rates. Moreover, as production factors are always made up of several elements, it will commonly be found that small errors cancel one another to some extent. Interim alterations of factors will therefore be an infrequent operation. At the end of the financial period, however, the balances in the factor accounts will come under review. As already stated these will be of

two kinds, those that have been planned and those that are unexpected. Of the former class may be instanced heavy expenditures on repairs of a building that it is desirable to spread over several periods. Balances of this kind will in every case be carried forward to the next account. Balances due to unexpected fluctuations must be dealt with on their merits, and this involves a clear view of their relation to the facts of production.

The object of any system of cost accounting is to represent current facts and conditions. By reducing all indirect expense to payments or rents for specified services we obtain a clearer picture of what the complex activity of a works means, and it is an obviously desirable idea to distinguish between occasional and recurrent classes of expenditure, and so to arrive at a standard rent charge fairly representing the normal cost of each service. It is for this reason that the expenditure on, for example, the repair of a building, is not necessarily considered as incident wholly on the financial period on which it was incurred. Or to reverse the case, it may be foreseen that heavy repairs will be necessary in three years' time. In settling the repairs element of that buildings factor, therefore, it is fixed at a figure sufficiently high to over-distribute beyond the actual current year's expense, so that by the time the repairs are undertaken a reserve is accumulated to meet their cost.

It will be seen therefore that over-distribution is equivalent to building up a reserve against future expenditure, or in other words, distribution by factors can be made to play the part of an equalisation account.

The fundamental principle of production-factor organisation is, therefore, not "averaging" but "equalisation." This equalisation takes place, not as between different jobs, but as between the cost of the same service at different financial periods, provided, of course, that the amount of the service rendered does not vary.

Discrepancies due to conditions that have been foreseen will therefore be dealt with as being in the nature of reserves designed for equalisation of the cost of services, where the expenditure on these is necessarily intermittent, although the service itself is both continuous and invariable. Such discrepancies, in the form of debit or credit balances, will therefore be carried forward to the next financial period.

Unexpected discrepancies are on a totally different footing. In general they will be errors. But they will be errors of perfectly definite and known amount, and to that extent under control. If they

are serious errors they will be rectified as soon as discovered, by a modification of the factor and of the machine rates. We have therefore only to consider what is to be done with minor errors, as, for instance the example shown in Figure 1, where a small undistributed balance in respect of painting remains at the end of the financial period (here considered as twelve months). Generally speaking there will be a number of such small discrepancies to be dealt with at the end of each financial period. The question of what is to be done with them is therefore an interesting one.

Strictly speaking, it is obvious that they should have been thrown on to work during the financial period in which they were incurred. This being so, it is equally obvious that they have nothing to do with the work in any other period. To carry them forward is merely to make a double error. Production in the first period having been unduly relieved of certain items of cost, to carry forward would be to burden production unduly in the second period in an equal but opposite degree. Theoretically, therefore, such errors should be limited to the inaccuracy they have already caused and not made the source of future inaccuracy.

It has already been pointed out, however, that these discrepancies will, in no case, be serious amounts. Practical considerations may therefore make it desirable to deal with them in an arbitrary manner. As they cannot be thrown on to work already done, only two methods of disposing of them remain. They can either be carried forward, or thrown into the supplementary rate for the last month of the financial period. This latter measure has the advantage of getting rid of them in a harmless manner, but it involves a dangerous precedent. It is, in fact, an example of the vicious principle of getting rid of expenditure "somehow" that is the prevailing characteristic of averaging methods.

Carrying forward, though objectionable from the point of view of pure theory, has practical advantages that outweigh the objections. It places unforeseen discrepancies on precisely the same footing as those that have been deliberately planned. As the only way of escape for undistributed expense is, in this case, through balances remaining in the factor accounts at the end of the financial period, it follows that all such items will be the subject of very careful scrutiny at the end of each financial period. These balances will, in fact, become the mirror in which the accuracy of the factor will be reflected, without exception. This is a practical advantage that out-

BUILDINGS FACTOR A/c _____ Shop

Components of Factor			Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Dr. Actual Expense	Cr. Per Factor	BALANCES Not Distrib.	BALANCES Over Distrib.
INTEREST DEP'C'N INSURANCE	Actual Expense	Dr.																
	Per Factor	Cr.																
LAND FACTOR	Actual Expense	Dr.																
	Per Factor	Cr.																
REPAIRS & M'TCE	Actual Expense	Dr.																
	Per Factor	Cr.																
PAINTING	Actual Expense	Dr.	—	—	—	$50	—	—	—	5	—	—	—	—	$55			
	Per Factor	Cr.	$4	4	4	4	4	4	4	4	4	4	4	4		$48	$7	
WHITE-WASHING	Actual Expense	Dr.																
	Per Factor	Cr.																
CLEANING	Actual Expense	Dr.																
	Per Factor	Cr.																
													TOTALS					

The Engineering Magazine

FIG. I. EXAMPLE OF A FACTOR CONTROLLING ACCOUNT.
Figures relating to one component are filled in to illustrate the method of working the Account.

weighs the slight theoretical inaccuracy introduced by the carrying forward of small balances from one period to the next.

Accounts similar to Figure 1 are kept for each production centre. In this case the items will be as detailed in the section on the "Practical Settlement of Machine Rates," the charges actually incurred for repairs and similar variable items being debited to the machine, month by month as incurred, and contrasted with the amount distributed by the machine rate. Such an account forms a most valuable life-history of the machine and is in accord with the modern principle of giving close attention to the cost, capacity, and output of each machine tool.

The general object of these control accounts is to determine the fixed elements of annual cost of each service, forecast the variable elements, and keep a close watch on the correspondence between the forecast and the actual expenditure. Further, they provide a means of equalising intermittent kinds of expenditure and making it bear fairly and equally on the work.

The Shop Balancing Account.

It was pointed out in the beginning of the installment that a simple means of ascertaining the amount of burden that had *not* been distributed at the tool point was desirable, for the purpose of ascertaining its proportion to the amount so distributed.

The diagram, Figure 2, shows the arrangements for doing this. The central feature is the "Shop Waste or Balancing Account." This ascertains the amount of machine rates not distributed on work—that is, the ratio of wasted to utilized capacity. The balancing account is debited with the monthly aggregate value of the various factors, and is credited by machine earnings. It will be obvious from what has already been said as to the relations of the machine-rate factors to the production factors, that if all the machines work full time the account will balance exactly. If they have been idle 25 per cent of the time, a quarter of the total burden will remain undistributed. But it will be remembered that all kinds of expenses of the nature of waste and loss fall into the supplementary rate. Among these were enumerated—spoiled work, loss caused by stoppage of power plant, extra payment for overtime, etc. These and similar items are collected by means of standing-order numbers and debited to the waste or balance account and as there is no factor in any machine rate corresponding to them, they can necessarily be distributed only in the supplementary rate. The latter is made up therefore of:—

1.—Factor values not distributed through machine rates.

2.—Expenses per standing orders due to losses of various kinds.

Machine rate earnings are collected and credited to the balance account by means of the monthly summary of work orders shown in the diagram, which summary also serves to make the distribution of supplementary rate over the various orders that have been worked on during the month. When all the orders with the amounts charged against each for material, wages, and machine rates have been tabulated, the total of the latter is ascertained and placed to credit of the balance account, which has already been debited with factor values and standing-order items as explained above. A balance is then struck and the ratio of the balance to the amount distributed is ascertained. This can be expressed as a percentage figure of the amount distributed, in which case the amounts chargeable to each works order are rapidly calculated on a comptometer or other machine and placed in the vacant column in the monthly summary sheet. If preferred, the balance may be distributed on an hour basis, which necessitates however that the total hours on each order be known. But, as before pointed out, this rate expresses only a ratio of unutilised or wasted capacity to utilised capacity, so that either distribution on an hour basis or by a *pro-rata* increase of the amounts already distributed can be employed, as convenience dictates. The hour method is preferable, but involves more work. Either method is equally correct.

When this distribution has been made the whole question of the actual incidence of the factors on work will have been cleared up for that period. It will be observed, however, that the supplementary rate is only distributed on each works order as a whole on its monthly total and not upon its constituent jobs. Thus the total cost of building a lathe will be expressed in material, wages, machine rates, and supplementary rate, but where detail costs are taken, they will not have any portion of the supplementary rate attached to them. Thus, the cost of planing the bed would consist of wages and machine rate alone. It would, of course, be possible to distribute the supplementary rate on individual jobs, but it would serve no useful purpose whatever. If such information were wanted, a simple calculation would give it, if we know the month it was done, and the percentage ratio, or the supplementary hour rate for that month. It is difficult to imagine, however, any circumstances in which such information would be of service. All the elements of actual cost are already represented when we know the wages and the machine time. The

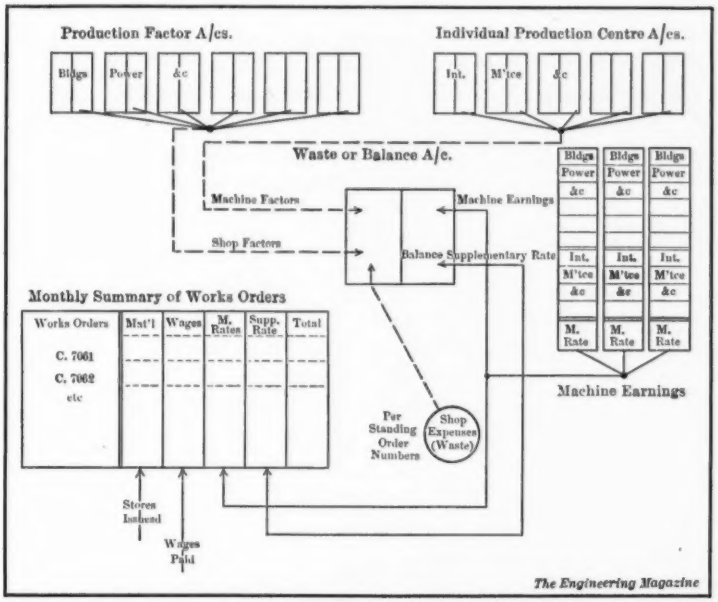


FIG. 2. DIAGRAM SHOWING CONTROLLING ACCOUNTS.
The various ledger accounts at the top of the diagram correspond with the several factors making up the machine rates. Consequently if all the machines work full-time, these ledger accounts are exactly balanced. For practical convenience an intermediate account called "Waste or Balance Account" is made use of, in which the debits and credits meet for ascertainment of the balance due to idle time, which is distributed as a supplementary rate.

ratio of utilised or unutilised capacity has no connection with any purpose for which *detail* costs are commonly required.

It may perhaps be advisable to point out that the function of the balance account is merely that of *measurement* of the amount of wasted indirect services to production. It is necessary to emphasise this, as it might be hastily assumed that the different factors, by being debited together to this account, were in fact thrown into a lump sum by that means and so distributed. That this is not so will be seen if it is considered that the actual distribution is not made by means of the sums so collected, but by the machine rates which are themselves made up of diversified factors. All that the balance account does is to provide *a means of subtracting the amount so distributed from the total, so as to ascertain the amount left undistributed.* The latter sum consists of factors all fused together, it is true, but as this remnant is waste, and belongs to no distinguishable

items of work, there is no longer any purpose in seeking to keep separate the elements of which it consists. The balance account is a convenient but not a necessary device for saving time. The credits might, in theory, be made direct to the factor accounts themselves and a number of separate balances struck. But no useful purpose would be served, because the separate items representing waste would eventually have to be aggregated to ascertain their ratio to utilised factors. The result would be exactly the same as that obtained with the short cut of the balance account.

Extension of Working Hours.

In every production factor there are certain components that are invariable and have no relation to the volume of output, and others that are variable according to the output, or rather according to the period of working. Speaking of the question of a shorter working day and the obstacles that stand in the way of its realisation, Professor Chapman has recently pointed out* that

> "the closest limit is imposed upon the reduction of hours by the heavy interest and depreciation charges with which the product of a machine is burdened when it works only a fraction of the time for which these charges must be paid. Buildings deteriorate in value at least as much when shut up as when occupied; machinery continues to wear out, and sometimes rapidly, when it is idle; and the reserve fund necessary because the market may contract at any time, and because machinery may at any time be rendered obsolete, is independent of the length of the working day."

On these considerations is based an argument for double or treble shifts.

> "The shifts for foremen and the management generally, which would have to be strengthened, might be arranged to run over a portion of two operatives' shifts, so as to cement the new work to the old."

Certain of the services, therefore, which are reduced to annual rents or factors under the present method will only be justly represented by those rents or factors as long as the normal working period, (say 2,700 hours per annum) *is not exceeded*. If, for example, a double shift were introduced, it is evident that the machine rates if unaltered, would distribute double the amount of the factors debited to the shop account, which would make the resulting balance a negative one, and the supplementary rate a minus quantity. This would, of course, be an absurdity. But beyond this, a little consideration will show that certain of the factors themselves would no longer be

* Address to Economic Section, British Association, Winnipeg, 1909.

correct. The *annual* value of the land and buildings factors would not, indeed, be altered, because no greater claim is made on these services whether the shop is working normal time or continuously day and night. But all factors containing variable elements, such as the power factor and that representing stores-transport, would be modified, since some components of those services would cost more for double shift than for normal working. The "strengthening" of the supervising staff referred to above would also necessarily modify that factor. In short, the whole internal economy of most of the services would be greatly changed.

This is as it should be. When working conditions are so wholly changed the organization becomes necessarily modified, and if this is followed by costs, comparison of the new factors with the old will provide a view of the relative efficiency of the two methods such as can be obtained in no other way. Or, rather, the composition of the factors as arranged for double-shift working will bring into full relief the direction and the extent to which increased efficiency is attained. No averaging or percentage method of dealing with indirect charges will provide information of this class at all. All that is revealed by such a method is that the percentages have fallen—a fact that is obvious enough already—but that certain elements are stationary and that some have increased is not brought to light. Worst of all, no guidance is given as to the nature or extent of the increases due to extended period of working.

On the production-factor method, the precise bearing on production of questions of interest and depreciation, building rents and charges, and all other invariable factors is visible all the time. The extent of gain to be made by intensifying production can be ascertained or forecast without any special searching or analysis. The components of every production factor, and also of every machine rate, *being always preserved separate and distinct,* the relative influence of such charges can be read almost as in an open book.

It must not be supposed that the working out of new factors for double shifts is as complex an operation as the original settlement of production factors. On the contrary, all the components of each factor being kept separate, modification of *those that involve increased expenditure* is all that is necessary, and the nature and extent of such additional expenditure will very quickly be ascertained, and substituted for the original figures. The reconstituted factors, divided by the new working period, say 5,400 hours, will provide the machine rates necessary for double-shift working.

While the settlement of factors for double or treble-shift working, or indeed, for any *definite* increase in the period of production, is as easy as or easier than the original determination for normal-period working, the same cannot be said of what may be termed "accidental" overtime, i. e., overtime which is irregular and intermittent. In averaging or percentage methods, overtime presents no difficulty for the simple reason that no account is or can be taken of idle machines, but burden is averaged over all work without regard to the question whether the expenditure has contributed in the slightest degree to the actual items under manufacture. On such methods the shop may be half-idle during a portion of the month and working overtime during the remainder of the month, but every item of work gets just the same average of burden, which is really equivalent to saying that the work in the idle period is escaping burden and the work in the busy period is being laden with burden with which it has nothing to do. Consequently, whatever else they may be, such cost figures are not, in any significant sense, genuine costs.

A similar state of things with production factors would, of course, maintain production costs, i. e., machine-rate figures, at their ordinary value, only the supplementary rate representing waste being affected by the idleness of half the shop during the first period.

Nevertheless, the question is one of great practical difficulty, because the conditions sought to be represented are in themselves complex. Normal machine rates are fixed for the purpose of distributing, in a normal year of 2,700 hours (or whatever the figure may be), the expenditure on the various services also calculated for a period of 2,700 hours. The difficulty arises if the period of 2,700 hours is exceeded, as in occasional and intermittent overtime, and it arises from the fact that certain of the components of the services remain stationary, whilst others do not, precisely as explained in regard to double-shift working. If, therefore, we have calculated our rates on a basis of 2,700 hours and we actually work 2,800, without modifying our machine rates, it is evident that there will be a departure from accuracy in respect of the components such as interest, depreciation, building factors, etc., which are stationary in value—that is, do not vary whether fewer or more hours are worked in the year. The extra distribution of other components will be balanced by extra expenditure on them.

Where overtime is accidental and temporary, and does not in any one year amount to more than a few per cent of the working hours (say 2,700) which constitute the normal basis, no serious disturb-

ance ensues; but should overtime become a regular feature, then this amounts to an extended working period "within the meaning of the act," and must be met by modification of rates as in the case of a double shift already described.

Owing to the importance of a thorough knowledge of the bearing of overtime on production, which at present is a much debated point, and on which no light can be thrown by any percentage system, I am in favour of isolating overtime operations from those of normal working, a process which would certainly make a very interesting study possible. I am hopeful that further investigations may presently allow this to be done in connection with production factors, by comparatively automatic arrangements, by at present no convenient and easily worked method has been arrived at.

The whole field of manufacturing production has now been covered, but the question of selling expense is so closely connected, that, although not of course amenable to any connection with machine rates or other shop devices and conditions, the subject cannot be regarded as closed without some consideration of this class of expense. In a final article, therefore, some hints on the matter will be offered, so as to enable a complete edifice to be presented, and the relation of all classes of manufacturing and selling activity to the financial books will be exhibited.

THE PROTECTION OF SUBMARINE STRUCTURES.

By Gen. W. A. Jones.

General Jones, through his long connection with the Engineer Corps of the U. S. Army and with lighthouse work, is too well-known to need any introduction.—THE EDITORS.

LIVING forms operate on submerged marine structures in two distinct ways: (1), on the surface; and (2), beneath the surface. In the first case, the seed germs and the newly born creatures, floating or swimming in the water, attach themselves to the surfaces against which they happen to bump, and there continue to live and grow to maturity. In the case of vessels moving through the water, a growth is developed upon their bottoms which causes skin friction, often very great, and this, in addition to the loss it produces by an increase in the time of transit, causes a most serious loss from the increase in the quantity of fuel consumed.

A multitude of growing forms attach themselves to submerged surfaces, especially in the warm waters of the tropics and the subtropics. They are both animal and vegetable, many of them building rough, hard, calcareous structures within which they live. A submerged surface, especially if stationary, becomes covered with this mixed animal and vegetable growth in an incredibly short time.

In the second case, newly born, swimming animals attach themselves to submerged structures of wood, which they enter within the surface and make their habitations therein. There are, doubtless, many cases where these creatures have the power of entering within the surfaces of submerged rocks, also, and making their habitations there. I know of one such case, that of a bivalve known as the "rock oyster" on the coast of Oregon. It is a clam, not an oyster. It carves, within the surface of a sandstone rock which is exposed at low-water stages of the tide, a cavity which fits its elongated, bivalve shell, increasing the size of the cavity with the increase in the size of the shell caused by its growth.

THE SHIPWORM.

In popular terms these creatures are called worms. But there are two, and one is not a worm. It is an insect. *Teredo navalis* is a worm. *Limnoria terebrans* is an insect. The *Teredo* uses sub-

merged wood as a habitation only. It feeds on infusorial matter that floats against its mouth, which protrudes a little while feeding from a very small hole in the surface of the wood. Operating just within the surface and along the grain of the wood, as it grows in length and diameter it has some means of cutting away the wood so as to adapt the dwelling to its varying size. The extension of its body in length is invariably in the direction of the grain, or fibres, of the wood. It has generally been thought that this cutting was done by boring, and this in spite of the doubt cast upon this theory by Sir William Thomson in 1837. I do not think anything in the nature of a boring apparatus has ever been observed upon this worm. It carries upon its anterior extremity, where all the cutting is done, a short, shelly structure, but it is not of such shape as can account for the cutting of wood by boring. The cutting is all done at and within a short distance of the anterior extremity of the worm, the remainder of the hole, as far forward as the orifice in the surface, being coated with a calcareous tube which the worm builds by deposition. The probability is that the creatures exude from the anterior surface of their bodies a chemically active substance which converts the wood into pulpy matter to be mechanically ejected into the water through the feeding orifice.

Limnoria terebrans is an insect, prodigious in numbers, that operates in wood in the same manner as the *Teredo* by making a multitude of holes just within the surface.

When the floating or swimming young of these forms strike against and effect a lodgement upon a possible habitat, they are in a very sensitive condition and seek shelter beneath small projections, or other growing forms, and here they commence cutting the tiny holes in the wood which are the beginnings of their future homes. It might be thought that in the early stages of their attack upon a ship's bottom, a good coat of paint, by shutting off their feeding orifices, would kill them all; but, as a matter of fact, it does not do so, and this is probably because the same means that are employed to destroy the wood are effective in destroying the paint. It may be stated, tersely, that these animals do not feed upon the wood. They destroy it by carving within the surface the cavities in which they live. They feed upon microscopic forms which float against their mouths exposed at the tiny holes in the surface of the wood. In this they resemble other marine forms. The coral, in stupendous colonies, builds its tubular habitat by depositing carbonate of lime around its body, and out of the front end of the tube it pokes a star-shaped mouth to catch the microscopic food that floats against it. The

oyster builds its home by depositing carbonate of lime around its sensitive body, opening the bivalve shell to expose its mouth to the microscopic food that floats along. The clam builds its dwelling in the same way, but burrows in the soft ground and pokes its mouth, at the end of a long snout, to catch the food that comes against it.

These little boring creatures have been the despair of the marine engineer. All his inventive genius has been arrayed against them, with unsatisfactory results. Perhaps the best protection against them is plenty of creosote forced into the pores of the wood to be protected. But I one day heard an engineer of much experience say that in time the worms "acquired the creosote habit." This is only another way of saying that creosote is soluble in 80 parts of water; that as soon as it dissolves and washes out of the surface of the wood, the young worms effect an entrance.

They operate between high and low-water stages of the tide, in sea-water that is not too cold. This is because the floating or swimming "fry" keeps near the surface of the water until it dies or bumps against a suitable habitat. They burrow along the grain of the wood, and this probably explains the immunity of palmetto piles. The fibres of this wood are round, with void or pithy spaces between them. The worm never cuts through the surface after it gets in. Every fibre of the palmetto has an exposed surface. Hence, as soon as a worm becomes nearly equal in diameter to the fibre it gets into it dies.

The process whereby they destroy wood is substantially as follows: the exterior layer of wood is first honeycombed, leaving a very thin shell on the surface exposed to the mechanical action of the water. There is a great deal of this action between the high and low-water stages of the tide, and it easily breaks through the weak surface layer, kills the exposed worms, and opens fresh surface for the attacks of the young worms.

The mechanical action of the water is, doubtless, a considerable factor in reducing the efficiency of creosote which has been forced into the surface of wood.

Protection Against Living Forms.

It is highly probable that the skins of the worms are very sensitive, and this leads to the suggestion, in the case of piles, of the use of kerosene oil, which is so destructive to worms and insects by simple contact. It has unusual powers of penetration. Bore a long hole from the top of a pile down along its axis as far as the high-

water mark, or farther. Keep this hole filled with kerosene oil, which, under the hydrostatic pressure and the capillary action will permeate the p'le to the surface in the danger zone and make the wood unbearable to the worms.

The habit of the worms in boring along the grain and keeping within the surface has led to a device which considerably increases the efficiency of submerged structures in wood. It consists in making piles and crib members square or rectangular in form, and covering them with one or two layers of thin boards well and properly nailed on with galvanized nails. The worms will not cut across the inside surface of the exterior layer of boards. So long as this surface is intact, no young worms can get through it. A modification of this device readily suggests itself, which should add much to its efficiency. Interpose barriers to the progress of the worms along the grain of the wood just within the exterior surface. Do this by driving rows of small galvanized nails, about ⅛ inch in diameter, at intervals of about one foot. Drive them ⅛ inch apart, and drive a row of galvanized brads about one inch long close along one side and directly opposite the intervals between the nails. Worms of larger diameter than 1-16 inch cannot cross such a barrier unless they flatten themselves to a ribbon shape, and the thin board would so reduce their size as to stop their growth before the board becomes so weakened as to give way to the mechanical action of the water.

The bottoms of wooden hulls, as well as stationary structures, are often sheathed with copper plates, but this is expensive and not always efficient for a long time. I have coated the danger zone of piles with copper, only to find that in about two years the copper rots and goes to pieces. Small wooden vessels are usually painted with a linseed-oil paint which contains a mineral poison that kills germs and young living forms by coagulation. It has been found that pulverized metallic copper in the pigment decomposes in sea-water and gives off such a poison, and since it is cheap it is much used in what are called "copper" paints. In a general way, it may be stated that paints which carry in their pigments certain poisonous salts of mercury, coppper, or metallic copper, will repel the germs and young of living forms for a short time. It would be interesting to know how these poisons get free from their oily envelopes so as to act in a coagulant way in the water. The best results from copper are obtained from the pulverized metal itself, which certainly has to undergo some chemical change before its poisonous qualities are developed. Creosote also acts as a coagulant poison, but I am not aware of its use in paints. It is a common practice to apply it

LIGHTHOUSE IN CHESAPEAKE BAY, IN 22 FEET OF WATER.
Rests on a cast-iron concrete-filled cylinder. Similar structures have not rusted either above or below water.

cold to piles with a brush, but this rapidly dissolves and washes away in the sea-water. It might be mixed hot with hot linseed oil, as a filler, for a paint vehicle that would be efficient and much more durable than the creosote alone. Special means for drying would be required.

When ships' bottoms are painted, the loss of time and earnings are so great while they are in dock that special driers are required for making the paint dry the same day it is applied. These driers are usually held as trade secrets, but they are based on well-known principles and can be readily detected.

Protection of Steel Hulls.

The protection of steel hulls is a dual proposition. The first coat of paint acts as a protection against rust. The final coat is charged

with a coagulant poison. In this connection it is to be said that the mild steel generally in use for the sheathing of ships and structural work on land is far more prone to rust than the wrought iron of former days. This is because it is a less homogeneous product.

The Cause of Rust.

Rust is oxidation, and in most, if not all, cases is the result of galvanic action, which deposits oxygen at one pole. Two dissimilar metals connected by a stratum of acidulated water produce galvanic action which decomposes the water and carries intensely active oxygen to one of the poles. Two pieces of the same metal not perfectly homogeneous will act in the same way. Wrought iron, especially mild steel, is far from homogeneous, and when acidulated water is brought against it the surface will become spotted with rust blisters —the poles of galvanic action. All water in the atmosphere carries

LIGHTHOUSE IN ALBEMARLE SOUND, RESTING ON FRAMED WROUGHT-IRON PILE WITH BROAD SCREW FLANGES.

Eighty years' American experience shows that rusting takes place principally for about 6 ft. up from the water surface.

carbonic acid in sufficient quantity to set up such action, and hence all iron exposed to the weather will rust—except cast iron. This is produced by slowly cooling from the fluid—infinitely divided—condition, and is nearly homogeneous. There can be but very little galvanic action between adjacent spots on its surface, and hence it rusts but little, either in air or water, salt, fresh or brackish.

In order that a paint shall protect iron from rust it is necessary that it shall prevent galvanic action. Now it is generally accepted that linseed oil is the best vehicle to go with the pigment that with it makes a paint skin. But such a paint skin will prevent rust for only a very short time. Such a paint soon becomes water absorbent and carries water through its body to the surface it is protecting. And furthermore, the drying (or rather hardening) goes on for a very long time, because it is an internal oxidation, and this oxidation is attended with the evolution of small quantities of carbonic acid, so that the water which gets upon the protected surface is the acidulated water required for producing rust. Hence, both the vehicle and the pigment that go to make a paint skin for steel hulls in water and structural steel on land should be so compounded as to minimize galvanic action. In the case of steel hulls, after such a first coat is applied, the second, or last, coat of practically the same composition, should carry with its pigment a coagulant poison. But since copper and its salts are so conducive to galvanic action in connection with steel, their use is not permissible for steel huils. A paint compounded for this purpose should be:

1.—Non-porous.

2.—Non-absorbent.

3.—Durable in water.

4.—Strongly adherent, and elastic.

5.—Hard enough to resist mild abrasion from floating bodies and from the mechanical action of the water.

6.—Charged with a coagulant poison that will remain efficient for several months.

An excellent method for increasing the adhesion is to apply the paint to the clean steel surface just after it has been heated with a blow torch. This opens the pores of the metal which close on cooling with the paint keyed into them.

Rust should be removed before painting and this is best done with the sand blast. It is well known that when linseed-oil paint is applied upon a rust-coated surface, the rust goes on under the paint. This is because the metal and the oxide are non-homogeneous, and when acidulated water comes through the paint skin, the conditions of rust are satisfied.

THE DESIGN, CONSTRUCTION AND OPERATION OF CENTRIFUGAL PUMPS.

By Franz zur Nedden.

III. STRUCTURAL FEATURES AND MANUFACTURING CONSIDERATIONS.

Mr. zur Nedden's critical discussion of the centrifugal pump, the third part of which is here presented, has already dealt with the mechanical and hydraulic losses of turbo-pumps, and solutions of the problem of balancing axial thrust. The present instalment is devoted to structual features and manufacturing considerations. The fourth and concluding section, which will follow next month, will consider the turbo-pump diagram and its practical interpretation in service.—THE EDITORS.

SETTING aside the influence of hydraulic theory upon the design of high-lift turbo-pumps, the principal points demanding attention are (1) cheapness in manufacture, (2) convenience of dismounting or repair, (3) reliability of performance.

MANUFACTURE.—Many engineers suppose that the manufacture of centrifugal pumps should afford a splendid opportunity for the modern method of mass production. In this they are absolutely mistaken. At most, the turbo-pump might be said to be suited to reduction to standard units. Unlike the reciprocating pump which allows a wide range of pressure and quantity of delivery in a single pattern, with no change of cylinder diameter, stroke or efficiency, by simply varying the number of revolutions and the counter-pressure—the turbo-pump theoretically must be adapted to each atmosphere of pressure and to a few gallons more or less in delivery by altering the impeller diameters, changing the internal dimensions of the chambers, and using different blade angles. The number of revolutions, however, must generally be looked upon as constant, as, for example, when the pump is direct coupled to a three-phase, alternating-current motor. The manufacturer, of course, must make some compromises and settle upon certain types. Correct judgment in determining these types is a masterly achievement, and will be decisive for the commercial success of the manufactory. This, however, is not the proper place to take up that topic in detail. Experience is the deciding factor. Mastery of this development of the art has been the foundation of the success of those firms which, for years past, have specialized in the building of turbo-pumps.

The second important point in manufacturing in standardized units is the mode of assembling the several single stages into a multiple unit. This is closely connected with the problem of dismounting spoken of above as the second cardinal problem of design. Two principal types are noteworthy—first, the closed casing, second, the so-called "girdle construction."

The first type is best represented by the turbo-pumps manufactured by Sulzer Brothers, by Schwartzkopff, Borsig, etc., and by Weise & Monski. Sections of the Weise & Monski and Schwartzkopff pumps were shown last month in Figures 17 and 23.* Figure 25 represents a longitudinal section of one of the older Sulzer types.

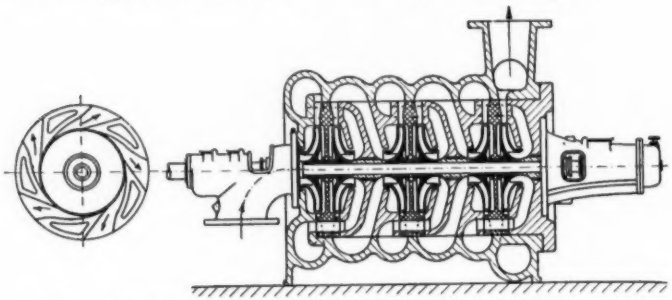


FIG. 25. SECTION OF SULZER BROTHERS' ORIGINAL TYPE MULTI-STAGE PUMP.

The fundamental peculiarities of the casing type are the following:

1.—Ability to remove the entire set of wheels as a single unit.

2.—Ability to remove the wheels without disconnecting either the suction or the discharge pipe.

The interior parts are held securely and absolutely concentric in the casing, which can easily and accurately be finished to a truly cylindrical bore. The advantage is much greater than might appear at first sight, because of the frequent necessity of dismounting and re-erecting these pumps by unskilled labor. In pumping liquids which carry sediment or contain acids, deposits or corrosions may occur in the fine joints, which, of necessity, are opened more or less by minor elastic deformations. Such deposits or corrosion will interfere in the most troublesome way with the removal of the interior parts of the pump as a whole, but in such case the removal may be made piece by piece with little delay. Every operating engineer knows the difficulties arising from rusted valves or valve seats in piston pumps. Impure water will always cause some difficulties. These are reduced to a minimum in the turbo-pump.

* THE ENGINEERING MAGAZINE, February, 1910, pages 697 and 701.

"GIRDLE CONSTRUCTION."—In this form the outer shell of the pump is formed directly by the diffusor wheels, which are fastened each one to its neighbor, or, as shown in Figure 26, are bolted in one group by cotters.

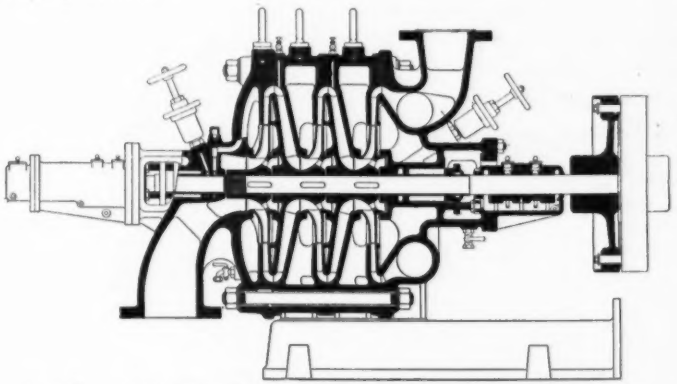


FIG. 26. GENERAL SECTION WORTHINGTON MULTI-STAGE TURBINE PUMP.

The advocates of this method, especially Jaeger-Worthington, advance many arguments in its favor, as, for example, the ease with which the girdles are dismounted, the great convenience of keeping separate parts in store, and consequently the possibility of great promptness of delivery. They point out that at any moment pumps of any desired number of stages can be built up from single girdles and impellers thus carried in stock. It certainly is of great advantage to the manufacturers that the girdles divide the pumps into units, each of very moderate cost and yet extraordinarily adaptable to occasional needs by combination in the required number. Nevertheless, each number of stages requires a special length of shaft, and of base plate. With a large order the possibility of very prompt erection may often become unimportant, because the driving motors, if not obtainable from stock, cannot be ready in an equally short time. Furthermore, it cannot be doubted that the necessity of disconnecting at least the suction pipe in order to dismount the pump is a disadvantage, even though in some cases this disconnection can be easily accomplished.

These considerations plainly suggest that, looking at the whole situation broadly, the two types of construction appear equal in advantages and disadvantages.

Some constructors (as, for example, Klein, Schanzlin and Becker, Frankenthal) have adopted a compromise. They adopt the casing, but divide it by a horizontal joint, Figure 27.

This arrangement still requires the disconnection of the suction pipe for any examination of the interior of the pump, for if the upper half of the casing be lifted it shows only the tightly closed shells of the diffusors. Hence the casing serves only to insure the exact position of the interior parts and to hold the whole thing together. It might be considered the equivalent of the cotter bolts in the Jaeger type. The Klein type of construction unites the advantages of easy dismounting, even under the difficulties attending the pumping of impure water (that is, the advantages of girdle construction) with the insurance of absolute concentric fixture of the interior parts, characteristic of the casing construction.

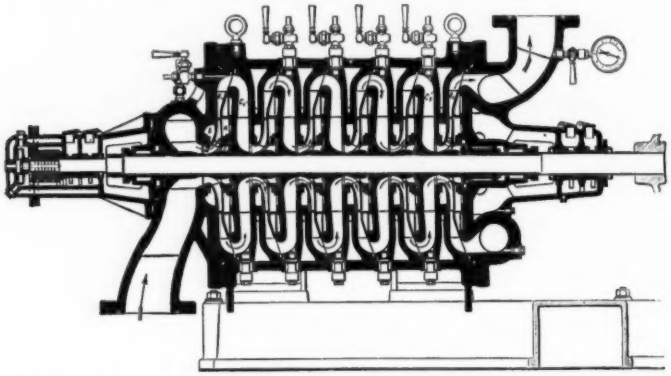


FIG. 27. GENERAL SECTION, KLEIN, SCHANZLIN & BECKER MULTI-STAGE PUMP.

The exterior shell is not utilized in any way to form passages for the water; thus easy removal of the interior parts at any time is assured. In the first place, the diffusors, when their faces are closely appressed, make an excellently tight joint. In the second place, the shell may be held down on machined surfaces by the screws of its horizontal flanges with a force exceeding any possible interior hydraulic pressure; in the third place, there is no additional elastic deformation when the pump is in operation, as the closed diffusors take up inwardly all radial forces due to water pressure. Therefore, there can be no opening between the diffusors and the shell in which and sedimentation or corrosion could take place. Nevertheless, this type of construction is somewhat complicated.

RELIABILITY OF PERFORMANCE.—Reliability, of course, must be the chief consideration in all mechanical construction. The chief points for the turbo-pump builder to keep in view, are, first, ample bearings thoroughly cooled; second, reliable stuffing boxes especially

tight against suction; third, freedom from shaft vibration; fourth, simplicity in construction and easy interchangeability of bearings and boxes.

The construction of bearings shows no new details when compared with modern steam-turbine construction. In the beginning much stress was placed upon the use of ball bearings. It is unfortunate that the defective performance of the early ball bearings and of the structural details of their use made it impossible to interchange them or to handle them with unskilled labor. The failures which nearly always resulted created a widespread prejudice against these bearings. Nevertheless, proper construction has always been attended by excellent results. The best proof of this can be found in some recent low-pressure types of one of the most prominent turbo-pump building firms, which are equipped not only with ball *thrust* bearings as hitherto, but the journal bearings also are all ball bearings. There is of course an immense difference between the flimsily assembled ball bearings that were known ten years ago, and the strong solid units sold by all the great manufacturers of ball bearings today. By the use of ball bearings mechanical losses are naturally much diminished and interchange and repair are effected more quickly and cheaply than is possible with any collar bearing.

Experience with the steam turbine is entirely unfit to furnish a precedent for the construction of stuffing boxes for rotary hydraulic machinery. We have seen already* that the principle adopted in the steam turbine stuffing boxes (that is, the labyrinth principle) is ineffectual against the leakage of water.

The basis of stuffing-box construction for high-lift turbo-pumps is the interposition of the greatest allowable *length* of clearance between the chamber of high pressure and the packing itself. The packing, then, need be tight only against the pressure remaining after the throttling effect of capillarity. Unlike piston-rod packings, the rotary stuffing box always touches the same part of the shaft. Wear and tear of the shaft is therefore inevitable in the long run if sufficient water irrigation is not provided. For this reason turbo-pump stuffing boxes must drip constantly. The suction stuffing box must be equipped in addition with a small water chamber between the packing and the interior of the pump, to which chamber water under pressure is usually supplied through a special pipe. Without this provision reliable air tightness could not be secured. The suction stuffing boxes, therefore, must also drip. Machinists or pump tenders would make a great mistake if they should try to stop this drip.

* The Engineering Magazine, January, 1910, page 556.

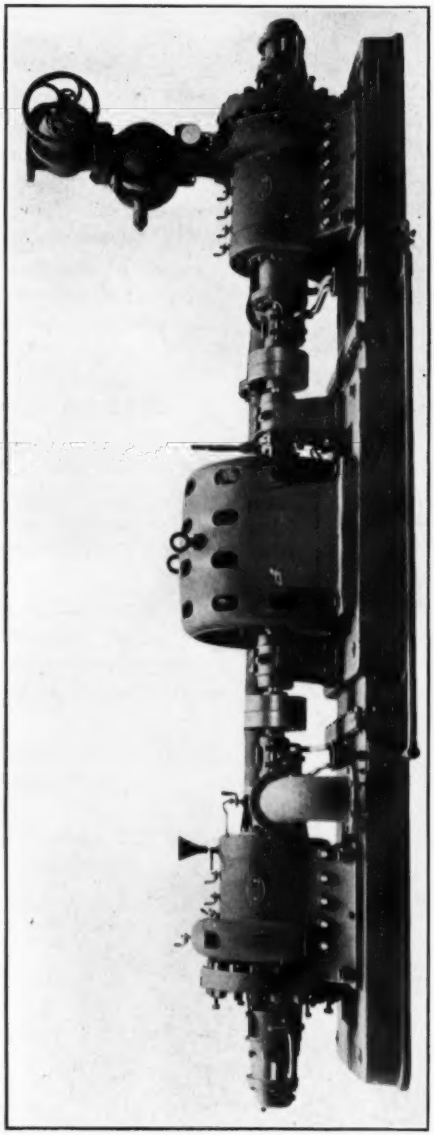


FIG. 28. THE SCHWARTZKOPFF MULTI-STAGE TURBINE PUMP COMBINED IN SERIES.

Perfect rigidity of the shaft is of the greatest importance to security of performance. The speed of revolution in an economical turbo-pump is always so high as to approach the critical limit for shafts which are only statically calculated. The methods of dynamic reckoning of shafts which have become generally known through steam-turbine construction must be adopted for turbo-pumps also. Furthermore, wheels must be balanced either singly, or, in the case of very high rotative speeds, in the entire set. Finally, the mere length of the shaft is of very great importance. Of course, a condensed or compact construction always favors general economy; here it becomes the vital point. This often means a serious problem or conflict of interests for the constructor. Considerations of high efficiency indicate small heads per wheel, that is, as many stages as possible; security of operation forbids the increase beyond

a certain maximum number. Especially in the case of very high heads and relatively small deliveries the designer must make up his mind to divide the number of stages between two separate casings, which must be joined in series. This arrangement is shown in Figure 28. The difficulties of checking the inclination of the shaft to vibrate immediately increase beyond control. Experience has shown that even with elastic couplings only by the highest perfection of shop work can a series of coupled shafts with a common axis be mounted on six bearings. Solid coupling is impossible for the simple reason that generally motors and pumps are built by different manufacturers. Only in rare cases is a simultaneous balancing of the whole set (the rotor of the motor and the two impeller sets) practicable. Without simultaneous balancing, safe running of a fast coupled high-speed aggregate cannot be expected. The perfect security of operation of large double aggregates elastically coupled has long since proved that careful shop work and erection will overcome these difficulties. Unfortunately, the limits of this discussion forbid taking up further details.

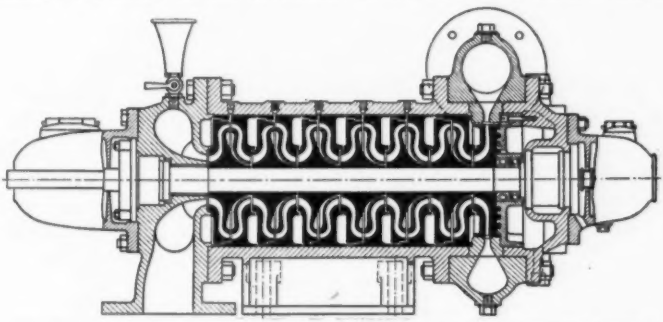


FIG. 29. GENERAL SECTION OF GELPCKE-KUGEL MULTI-STAGE TURBINE PUMP.

SPECIAL TYPES OF HIGH-LIFT TURBO-PUMPS.

For the sake of completeness it may be well to refer to some systems of pumps which caused (and to some extent still cause) sensation by their peculiarities. For example, Figure 29 represents the longitudinal section of a pump on the Kugel-Gelpcke system. The inventors endeavored to reduce the diameter of the casing to a minimum, and to accomplish this they gave the cross section of the impeller chambers the form of the letter S, so that they discharge into the guide channels, not radially, but axially. The guide channels, also S shaped, not only transform velocity into pressure, but simultaneously lead the water centrally into the entrance of the next impeller. This

system, at first sight apparently very attractive, has been wholly abandoned. Its sensitiveness to inaccuracies of manufacture makes it impracticable. We have already seen that volumetric losses depend wholly upon the absolute area of the clearances. It therefore follows that, given equal accuracy of machining, (that is, equal clearance) the volumetric losses will be largest in that joint which is of greatest diameter. The joint of the Kugel-Gelpcke pump is on the greatest diameter. Furthermore, in this type the constructors were limited in both the axial and radial direction; neither the slightest eccentricity of the wheels nor the slightest axial shifting is permissible. Correct erection becomes entirely impossible, and almost insurmountable difficulties arise in the replacement of single parts subsequently delivered. Moreover, wear and tear are extremely destructive.

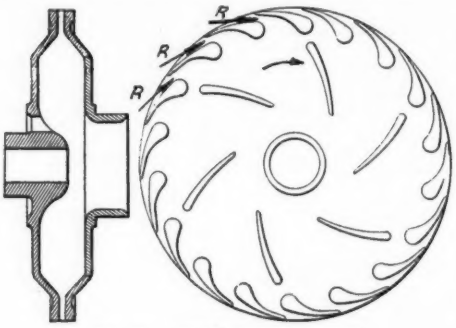


FIG. 30. REES'S ROTURBO PUMP.

A second sensational system is the Rees "Roturbo" pump constructed by Messrs. Thomas Parker, Ltd., of Wolverhampton. The construction of the impeller illustrated in Figure 30 is based on the supposition that the connection between the entrance and outlet angles of the blades is of no importance—an assumption which can be supported by a good theoretical defense. For this reason Rees depends only upon the ribs to prevent excessive whirling of the water inside the expanded rotor casting. The formation of a vortex within this chamber would not be especially harmful, as the large dimensions permit a low velocity. The essential of the inventor's idea is found in the shape of the small outlet blades by which the outlet channels are reduced to their smallest cross-sectional area before they run into the periphery. The result is a second retarding of the water near the periphery of the rotor. A nozzle effect is produced, causing a reaction in the direction of the arrows R R. These forces produce a torsional moment acting in the same direction as the driving moment. If the cross-sectional dimensions are properly fixed this auxiliary moment of torsion begins at a certain delivery to increase faster than the driving moment. It follows that if the delivery be further increased the driving power which the pump demands from

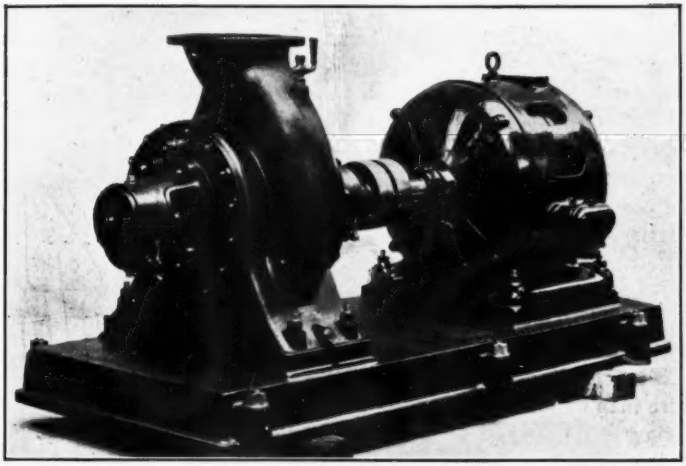


FIG. 31. WEISE & MONSKI LOW-LIFT TURBO-PUMP WITHOUT GUIDE WHEELS.

the motor falls. It is clear that this pump can never overload its motor, and therefore it is suited to all conditions where the head and consequently the delivery may vary considerably through causes independent of the act of the attendant—as, for example, where the pump serves a dock basin under a suction head varying with the level of the tide. These peculiar and still quite economical pumps are consequently to be found at work at many English sea-ports.

Messrs. James Simpson & Co., Ltd., Newark, Notts., claim a similar advantage for their multi-stage pumps. These pumps are distinguished by the contraction of the many guide vanes which the

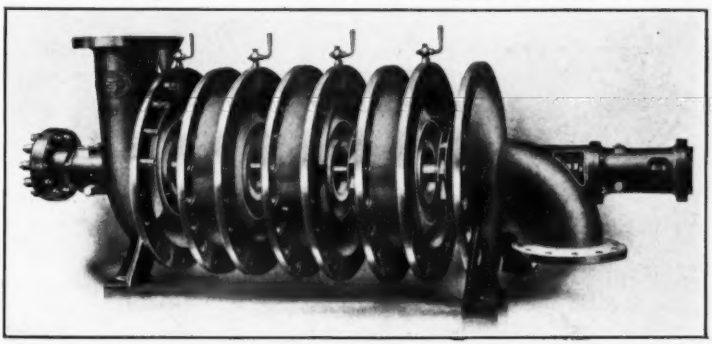


FIG. 32. WORTHINGTON NEW-STYLE HIGH-LIFT CENTRIFUGAL PUMP SHOWING INTERMEDIATE STAGES.

normal centrifugal pump shows in a single one. That is to say, instead of several or many diffusing channels, these pumps have but a single helical casing designed with extreme care, and with exact regard for hydraulic laws. They represent a return to the original centrifugal pump without guide vanes, but the shape is determined by application of all the experience obtained in the use of guides.

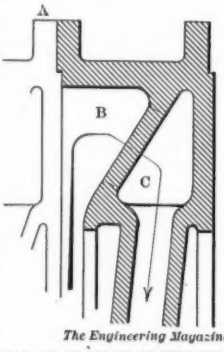


FIG. 33. SECTION OF THE DIFFUSOR OF A SIMPSON PUMP.

It is recognized that pumps without guide wheels may operate at high speeds with good economy. An example is shown in the Weise & Monski single-stage turbo-pump without guide vanes, illustrated in Figure 31. This machine exhibited a maximum efficiency of more than 82 per cent in the delivery of about 2,000 gallons per minute at 60-feet head, with 1,000 r.p.m. The principle patented by Messrs. James Simpson & Co. is the juxtaposition of several such spirals in a single casing (Figure 32). This is accomplished by giving the helical diffusor a trapezoidal section as shown at B in Figure 33. If a second similar trapezoid C be assembled next to this, as shown in Figure 33, is is clear that a rectangular figure results. The area B may be increased by a corresponding decrease of the area C, while the radial dimension A A is yet kept constant. Messrs. Simpson & Co. utilize the area C to conduct the water under pressure as it comes from the helical diffusor B back to the center and into the next impeller. The course of the water is indicated by the arrows in Figure 34.

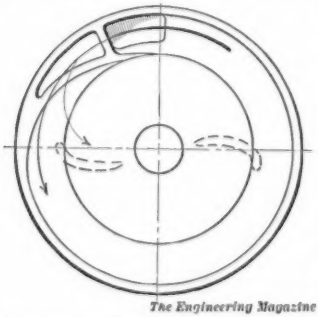


FIG. 34. COURSE OF THE WATER IN A SIMPSON PUMP.

The attendant problem is that of governing water of high velocity with safety and in conformity to exact mathematical principles. The constructors have mastered this difficulty by using cores of special design in the molding of the diffusing spiral. The results simultaneously secured are absolute exactness of form, perfect smoothness of surface (with resultant minimum of friction), and (by chilling) the greatest attainable hardness. The maximum head per stage at which these pumps have worked is stated by the manufacturers to be 360 feet.

ENGINEERING AND ECONOMIC ASPECTS OF LOW-GRADE COPPER DEPOSITS.

By C. F. Tolman.

Mr. Tolman examines, in the following pages, the economic importance of copper, and considers the extent and probable life of the world's supplies of copper minerals. He shows the important *rôle* which low-grade ores will play in the future history of copper, and directs particular attention to that type of deposit most recently developed in the United States, the chalcocite disseminations in schist, the engineering and economic aspects of which he discusses at length.—THE EDITORS.

THE preservation idea is young, and perhaps it is too much to expect a full conception of its meaning among even its most active advocates. Prompted by this great movement, the United States Geological Survey has been carrying on an active campaign of inventorying the natural resources of the United States, and its estimates of supply in sight are all read in terms of a few hundred years at most. In regard to copper it is stated: "The whole problem of the copper supply contains so many unknown quantities that final and definite judgment is impossible. In the last analysis, however, it comes down to a question whether it is better for a country to reserve its copper for the future, *when its value is an unknown quantity*, or to extract the ore as rapidly as possible when the profit is assured." Surely a rather remarkable suggestion, that there is a possibility that in the future copper will have small economic value.

It is evident from the above that we are thinking of preservation in the terms of a hundred or a few hundred years at most. From this narrow point of view there is an abundance of copper. But the geologist looking back at the history of the various animal species, and admitting that short span of life is allotted to the more highly organized animals, will hardly be willing to limit the life of the human race to a few hundred years, but must entertain the possibility that it may be measured in terms of thousands of years, or perhaps a ten-thousand-year period or so. With this possibility in view, and believing that our duty to posterity does not cease with our children but extends to our children's children, we may well look a little further into the future. This is not as profitless as it appears at first sight, for the general conditions confronting the race are indicated with certainty, and the only

Pinal Mountains Red Rock Red Spring Shaft

Keystone Tunnel Captain Red Rock

VIEWS ON THE PROPERTIES OF THE MIAMI COPPER COMPANY, TAKEN IN MARCH, 1909.

unsolved question is what integer to use in expressing the number of hundreds of years before these changes are upon us.

Future Conditions and the Necessity for Copper.

Coal will fail for the needs of industry. The investigations of Mr. Bailey Willis in China indicate that that convenient hypothetical source of supply, which was to do for the future generations, is largely a myth; and Mr. David White shows that the Appalachian supply has been greatly overestimated by the Geological Survey. These details aside, that will only make a difference of a few hundreds of years either way; the future of the United States is limited by the thirty million horse power that is easily available in its running streams, by the unknown amount that will be developed in the far future by the complete control of all the streams and the utilization of all their energy by dams, etc., and by the solar energy and that of the tides. The prompt exhaustion of coal will only accelerate the development of these other resources, which fortunately are furnished as a constant supply and not as an accumulation that can be wasted recklessly. The other main factor which will limit the prosperity of the human race is the food supply, which again is a function of the water supply and that of fertilizers; but this need not be considered here. The indispensable mineral products of the future are iron, cement, aluminium and copper, the latter mainly for the distribution of energy over the world. The first three are sufficient for any conceivable long life for the race, for the treatment of the low-grade and refractory iron ores will be accomplished under the stress of necessity by our children. Aluminium can, of course, be substituted in part for copper, but with many drawbacks, and one of the greatest needs of the future will be a metal for the transmission of power; for this nothing equals copper.

The Great Copper Fields of the World and Their Promise of Future Production.

In order to get some idea of the value to the world of the newly discovered asset, viz., the disseminated chalcocite deposits in schists, it is advisable to review the copper fields of most promise. In South America the Cerro de Pasco and the Braden Copper Co. are proofs of the possibilities of this continent. It appears that the deposits are of types similar to those of western United States, but they possibly are more scattered, and as yet it would seem hardly justifiable to assume that there is a producing field here comparable with that of the United States. The African copper deposits have been given high value and immense tonnages in the reports of the English com-

panies exploring them. Descriptions of these deposits as hills of copper-bearing sandstone suggest that the indurated outcrops are very conspicuous, and if this is a general characteristic of these deposits, many of them are probably already located. Mexico shows occassional valuable copper deposits the length of the Sierra Madre, but everywhere the telltale surface indications are of easy interpretation, and the most striking of these are located. The more extensive Sonoran fields are extensions of the Southern Arizona area, and these two can better be considered as a unit.

The Copper Fields of the United States.

It is of course known to everybody that North America is the copper continent, and that the most productive and promising fields are located within the territory of the United States. The fact that the relations between geology and structure and the deposition of copper have proved to be so various, and yet controlling in the formation of commercial copper deposits—that surface indications give us more definite evidence as to the existence of underlying copper deposits than in the case of any other metal deposits—has given an absorbing interest to the study of the ore deposits of this metal, and in consequence they have received more attention at the hands of American geologists than all other kinds of ore deposits combined.

Of the various classes of copper deposits, those of Michigan are a law unto themselves, utterly unlike those developed elsewhere in the United States, and there appears little probability of finding others of this type outside of Alaska, where prospects are reported resembling the Lake Superior deposits. The California and Tennessee low-grade massive copper-bearing pyrite deposits are a small factor and promise only moderate increase.

Ten of the thirteen great copper camps of the United States are put in one major group on account of similarity in the following respects: (1) They are at or near the margins of granitic igneous intrusions (either granite in its widest sense as a field name or granitic porphyry). (2) The instrusions occurred at the same time (geologically), in the late mesozoic and early tertiary periods. (3) The copper-charged solutions that formed the deposits are believed to have been furnished by the intrusions. This group is divided into certain subdivisions as follows, and at least some approximation of their future importance may be hazarded.

A. Certain of the deposits occur as great lodes in the intrusive granite. The surface indications are more or less iron-stained outcrops with gold and silver values left behind near the surface by the

CLASSIFICATION OF AMERICAN COPPER DEPOSITS.

PRE-CAMBRIAN DEPOSITS.

1. Lake Superior, Michigan.
2. Ducktown, Tennessee.
3. Jerome, Arizona (Uncertainly placed here).

DEPOSITS CONNECTED WITH LATE MESOZOIC-EARLY TERTIARY INTRUSIONS.

Arizona.

4. Bisbee.
5. Morenci-Metcalf.
6. Globe Hills.
7. Miami-Inspiration.
8. Ray.

California.

9. Iron Mountain (Probably belongs here).
10. Bully Hill " " "

Utah.

11. Bingham.

Nevada.

12. Ely.

Montana.

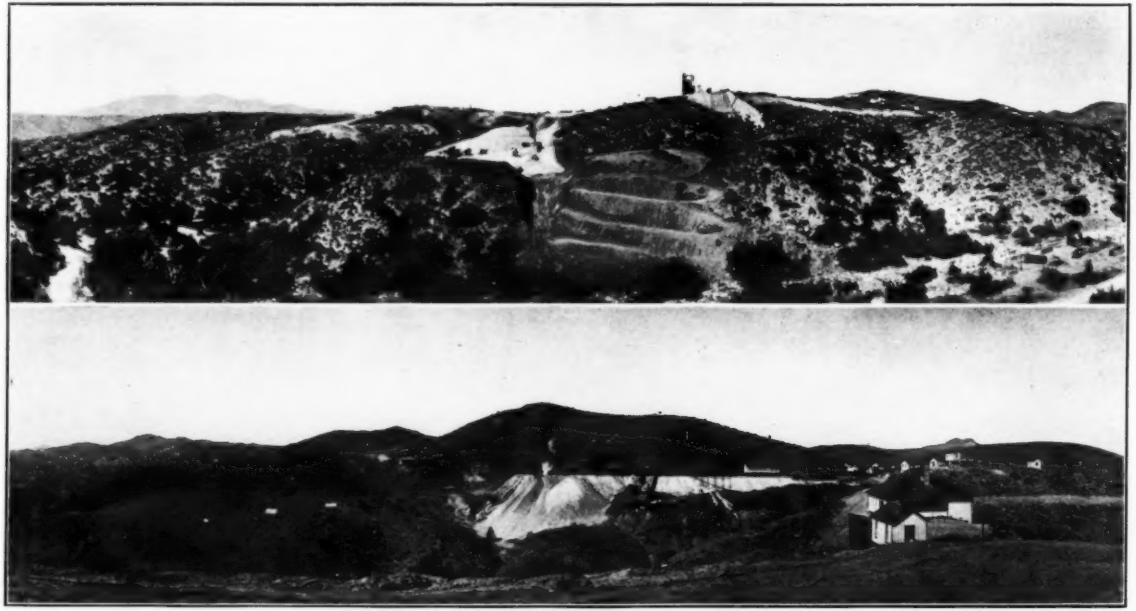
13. Butte.

Besides these more important camps, most of the small camps and promising prospects of Utah, Nevada, Arizona, New Mexico, and Sonora, Mexico, belong to this second group.

downward leaching of the copper values. Butte is the great example, and in spite of the knowledge of the characteristics of this class of deposits and active prospecting and exploitation for the same during the last fifteen years, there have been no startling new discoveries and the chances do not seem to be bright for the opening up of many new Buttes.

B. The second extensive and prolific class of copper deposits occur as lenses and tabular deposits in limestone near the contact with the intrusion, or developed out from fissures reaching down towards the intrusion. These deposits are among the most productive, especially in Arizona, Bisbee, Globe and Silverbell being well-known examples. Many of these have prominent croppings of either iron gossan with copper stain, or more or less decomposed garnet caps with copper minerals. Many such outcrops are being held and prospected by miners or small companies, but even the most promising known to me hardly give promise of repeating the wonderful history of Bisbee. In brief, the outlook for new limestone copper deposits is very good, but the surface and structural features are so well-known that possibly a majority of these deposits are already located and waiting for development.

C. Disseminations in porphyries. These have recently received attention from large operators and the investing public, and at least



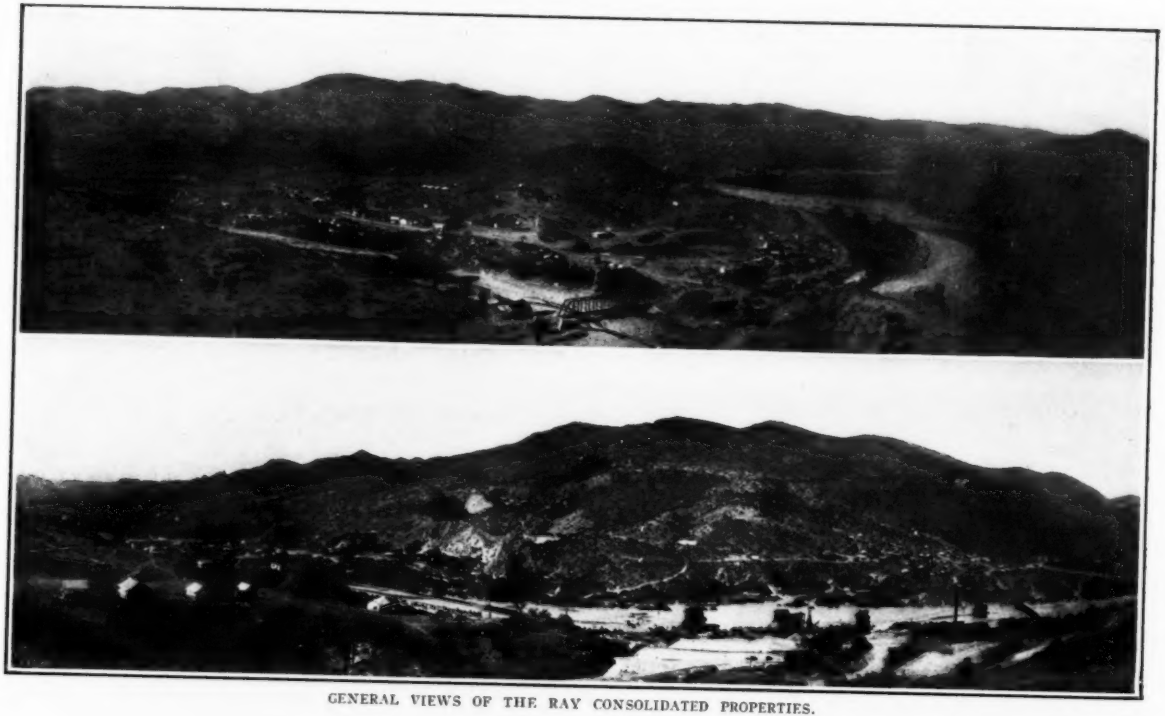
Captain Red Rock

VIEWS ON THE PROPERTIES OF THE MIAMI COPPER COMPANY, TAKEN IN MARCH, 1909.

one of the recently developed mines has shown its class by producing copper near the seven-cent figure. On account of the large size of the deposits, the blocking out of the ore in advance by churn drilling, and the use of steam shovels for the winning of the ore, the descriptive phrase "copper manufacturing" rather than copper mining has been suggested. The productive capacity and the effect of the flood of copper to be turned from these mines has probably been over-estimated. Their importance as an economic factor is largely due to the fact that many of them will produce copper at a lower figure than most of the mines belonging to the other classes. The geological factors that govern in this type are: (1) The intrusion must retain throughout its mass a small portion of its copper content, and (2) by thorough and slow leaching the copper values are driven downward and concentrated into extensive but very low-grade ore. In regard to the probability of finding other Binghams and Elys, it may be remarked that the productive and promising porphyries of this kind found up to date develop the well-known contact deposits in the adjacent rocks, and that the copper indications of the latter were recognized long before the economic importance of the porphyries was appreciated. While promising deposits of this type are being developed in Arizona and Sonora especially, the surface indications of a copper-bearing intrusion and its contact deposits are so easily read that it is probable that a considerable portion of the most attractive of these have been located, and are held by prospectors and prospecting companies.

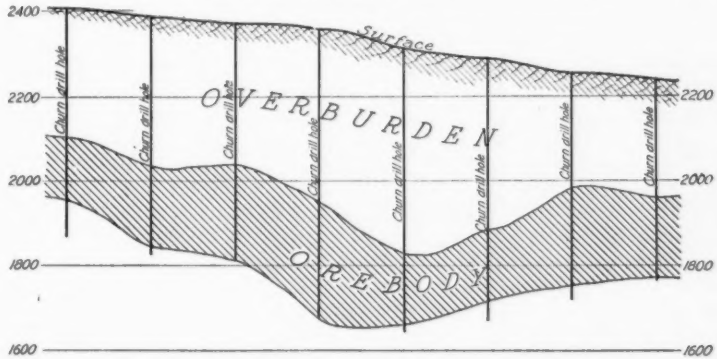
The statements that have appeared recently to the effect that great areas of low-grade copper-bearing porphyries will probably be found in other countries as well as in the United States is perhaps over-sanguine, if we may judge by the fact that the other well-known classes of contact deposits that accompany the porphyries are scattering.

D. The disseminations in schists. The recently developed Arizona disseminations belong to this new class. The Ray Consolidated Copper Company and the Miami Copper Company are the best known to the investing public, but many other corporations are testing the areas in which these occur. In brief, the Ray deposit is a continuous underground sheet over 100 feet in average thickness of commercial ore (commercial ore in connection with these deposits is generally taken to mean a 1½ per cent copper content or over). The schist is intruded by a granite which undoubtedly generated the original copper-depositing circulation, and after the cooling of



GENERAL VIEWS OF THE RAY CONSOLIDATED PROPERTIES.

the latter, the original low-grade non-commercial deposits have been enriched by the slow, even sinking of the soluble copper salts throughout the mass of the country rock, in this case mainly schist but which also contains dikes and lenses of granite and sills of diabase. The descending solutions finally reach the unaltered original sulphides, and the copper there deposits around and replaces the iron sulphide, as specks of easily concentrated black copper sulphide. The lateral limits of this ore stratum have not as yet been definitely determined; the Ray Consolidated, the Ray Central, the Gila Copper and the Hercules and Arizona Companies are all working on the same ore sheet.



SECTION THROUGH A PORTION OF THE RAY OREBODY, SHOWING THE CONTINUITY OF THE ORE-BEARING STRATUM.

The second well known ore-bearing schist zone is found along the contact between the Schultze granite (very like the Ray granite) and the Pinal schist. Development here suggests that the ore is not a continuous sheet, but lies in huge irregular shoots (in the Miami the first ore body developed has the shape of an inverted cone). These shoots are governed by structural features (mainly faults, dikes, and silicified breccias) and at the Miami at least the ore is of higher grade and deeper occurrence than that of the Ray sheet.

In the past, mining explorations have been governed by the prejudices of the prospector and the miner rather than by the scientific study of ore bodies. Often the value of a deposit has been determined by some headstrong miner who has not agreed with the notions of his fellows, and thereby a new type has been added to the list, to be searched for thereafter by the prospectors. Heretofore there has been a strong prejudice against granite as a copper-bearing form-

aiton. We now know that in the western mineral region of the United States there are two classes of granite; viz., an earlier pre-Cambrian granite apparently inert as far as the development of copper deposits is concerned, and a much later granite of the same epoch and with the same mineral-developing activities as the better known copper-bearing porphyries. Until recently porphyry and limestone were thought to contain all the southeastern Arizona copper deposits of any value. Now the value of the neglected schist is appreciated. The demonstration of the value of the Miami was the result of the good judgment of Mr. J. Parke Channing, who was neither affected by the prejudice of the miners, nor misled by the erroneous classification of the Schultze granite as pre-Cambrian by the United States Geological Survey in its study of the region. Equal credit is due to the foresight of Mr. Philip Wiseman, who saw the economic value of the sulphide-specked schist at Ray, in spite of the failure of the earlier companies in attempting to mine copper stringers and veinlets, and in overlooking the possibilities of the low-grade country rock.

The courage and resources of these developing companies have given us definite data for future explorations. We now know that the effect of primary mineralization and secondary concentration can be seen in the barren rock above the ore bodies, which once contained the low-grade primary ore and has been robbed of the same by meteoric waters. The surface leaching, however, has not been able to efface the indications of the primary ore and the processes of enrichment. Further, the study of these two areas shows again the vital relation between the intrusion and the mineralization, and at Miami especially is shown the effects of the minor structural features, such as the silicified breccias, the faults, and the dikes, in concentrating the values into ore shoots.

Lessons for the Mining Geologist in These Deposits.

It is rash as yet to guess at the possible future importance of this new class of deposits, but in this connection it is at least interesting to note that they are limited to the contact of the later granites with the schist, and that these intrusions are especially abundant in southern Arizona, south of the Mogollon escarpment, and that the schist is widely distributed throughout the same region. But by no means all the later intrusions have given off copper-charged solutions, and the mere fact that schists and granite or granitic porphyry are in contact does not indicate copper deposition. The indications discovered at Ray and Miami must be recognized by the trained engineer, or

else the exploration of a granite-schist contact is not a legitimate mining proposition.

Opportunities Offered in the Mining of These Bodies.

The schist disseminations as found up to date are too deep for mining by steam-shovel or glory-hole methods. With a 200 to 300-foot overburden, which is equal or greater than the thickness of the ore stratum, such attacks are futile. The ore must be removed by caving methods, and not on a small scale as in the various methods of roof caving and sub-level caving; a large section of the ore body must be broken and self-ground by the combined use of powder and gravity. Large rooms will be cheaply excavated by some modification of the system known as "back stoping" where the miners shoot down a slab from the roof of the room, the broken ore filling the excavation, and only the excess being drawn off, so that the miners can again attack the roof by standing on the broken ore. These large rooms must be arranged throughout the ore body so that they will stand when filled with ore, but when the ore is drawn off from the rooms, the pillars must collapse, and the entire ore body and overburden be drawn down evenly so as to make a minimum mixing of ore and waste. The nearest approach to this method is now being used by the Boston Consolidated Copper Co. at Bingham, where it has been adopted in preference to the steam-shovel method formerly used. The details of such a method for the larger Ray ore sheet, the way in which the rooms are to be stoped, the pillars weakened, and the ore drawn off, are yet to be developed. It is in connection with problems such as these that the talent of the mining engineer will be employed. It is not too much to say that the future dividends from the Ray and the Miami-Inspiration ore bodies depend on how successfully these problems are solved by the companies' engineers.

Opportunities for the Investor.

Will it always be necessary for the investor to wait until the exploration company (close corporation of successful mine operators) turns over the property at a handsome profit to a development company, (also a close corporation of a favored few) which in turn permits certain financial firms (with a proper profit to all concerned) to present the proposition to the investing public? Apparently the only other way the public can share in such a venture is through a stock company organized to develop and equip prospects generally miscalled mines; and it must be confessed that the ordinary development stock companies are an abomination, attempting generally to

enter into a business of which they have no knowledge, at best extravagant in their methods of reaching the public, and worst of all making such representations of their particular prospect that unless they make good in the development of this one prospect (the chances are against any one prospect even if it is a good one), they are lost. It would seem, however, that there is a chance for an exploration company, supported directly by the public, and employing competent technical advice, to carry on exploration work for disseminated deposits along the same lines that are so successfully being followed by certain mine operators.

Opportunities for the National Government.

The American continent is rich above all others in mineral wealth. In the development of our copper resources, we have been casting the spoils of this continent on a glutted market and crying overproduction. We have little reason to suppose that the discoveries of the future will compare with those of the past, and yet to my knowledge not one promising copper deposit has been saved for the future. We have talked of the law of supply and demand, when nothing is more certain than that the law is reversed in this case—that if copper drops in price, the mine must produce more ore and better ore to pay expenses and dividends. If the Government is obligated to preserve coal, oil, etc., its duty is at least equal to preserve the copper supply. If the waste in the mining and metallurgy of copper has been less than, say, in the mining of coal, the loss has been increased by the glutting of the market at times of low prices, by the larger mines which cannot shut down. The production of the large number of prospects that shut down upon the development of an unfavorable market, does not equal the production of a single mine of first magnitude.

The need of protecting the remaining copper supply seems real, but it is certain that the Government will not and cannot take steps in time. No copper mine has been developed that did not have indications of the underlying deposit at the surface. The meaning of these indications were not appreciated in certain cases, but now that the ore bodies have been exploited, and the outcrops studied, the conditions are changed. The progressive copper corporations have their trained men everywhere. In a few years more it would seem that the cream of Alaska, South America and Africa will be taken up. The Government has lost its opportunity, and copper is to a large extent at present, and will be even more in the future, controlled by the progressive copper operators.

EDITORIAL COMMENT

A New Industrial Philosophy.

MR. GANTT'S articles, which began last month and deserve the prominence given to the series again in this issue, raise the image of a very interesting possibility affecting the future of trades-unionism. The unions today are admittedly the most serious menace to industrial stability. Organized labor is usually found alert and implacable—or at least strongly hostile—to the attempt to introduce any of the advanced wage systems. This concept, then—that one of the farthest-reaching of these systems will itself be found not only a stabilizing force, but an institution to which the men will turn with welcome, and to which they will cling for better help than unionism—has a fine optimism that challenges attention and excites respect even in those who remain doubtful.

But the proposition rests on a basis of fundamental truth which (if we believe that truth will always finally prevail) we must believe will eventually be accepted by all, whatever resistance to its acceptance may now exist. This proposition is that wages should be made more nearly proportionate to work done than they usually are under present methods. It should be very much easier than it is now for the good workman to increase his earnings, to double or treble or multiply his earnings, if by diligence and skill he can double or treble or multiply his output. Nevertheless it must be recognized fully that probably the greatest difficulty in establishing any such change—the greatest difficulty in the way of introducing anything but the level class wage rate—is the opposition of the men themselves. Bitter past experience has taught them to fear individual bargain or individual adjustment of wages as the probable approach to individual reduction to a minimum. They can not set that experience aside and welcome easily to their confidence a new mode of individual adjustment, even though its declared purpose is to raise the individual earnings to a maximum. They have so long had to find their only defense in that primal institution—the herd or the pack—that they have a deep-rooted suspicion of every attempt, however benevolent, to weaken that defense (as it seems to them) by introducing gradations within the class and so in some way introducing differences of interest among different members and breaking up the class cohesion. We are apt to overlook or misconstrue the force of this defensive instinct nowadays, and to think of unionism as chiefly offensive and generally evil. This is not strange when we are forced to see what unfair, unreasonable, and criminal demands a trades union can conceive and insist upon when the power has passed into its hands. But pernicious unionism is not altogether a case of original sin in the workingman. It is imitative sin, retaliatory sin, called forth by acts originating with employers. This is not individually true of each present modern instance, but it is true of the historic descent and ancestry of the attitude between employees and employers even if not of specific cases arising today. The sins of the fathers are being visited on the children in the persons of employers of the twentieth century. The first impulse of the employee, toward almost any proposition advanced by the employer, is one of suspicion, distrust, resistance. This opposition by the men can be abated only by great wisdom and patience in the introduction of new methods and by absolute good faith in carrying them out.

The reward of success, however, is large to both sides. To the employee it comes directly in increased earnings. To the employer it comes almost equally directly; for if under the stimulus of wages proportionate to effort his men increase their efficiency, the output of the factory is increased without any cost for enlargement or any increase of any fixed expense. The cost of production is lowered, and the profit of the business is correspondingly increased. It is not strange, then, that a number of minds of the first order have been concentrated on the development of plans which are designed to stimulate individual effort by the incentive of individual reward. Of these plans, Mr. Gantt's are by no means least interesting.

Welfare Work.

THE query discussed by Mr. Falconer is anotner article in this issue is one upon which there has been, and is still, much debate. A number of manufacturers and manufacturing corporations have attracted wide notice by introducing remarkable and far-reaching provisions for comfort, not only in but out of working hours.

There are moral reasons why the employer should care for the welfare of the employee; but without going beyond a strictly utilitarian philosophy we may lay down with absolute certainty the following premises as the basis for a scheme of industrial relations that will profit the employer as well as the employee. These premises are that good work can not be done or kept up continuously without good light properly distributed; nor without good ventilation and a proper working temperature varying with the activity of the occupation; that efficient performance is impossible when the operative is exhausted by needless fatigue or is exposed to noxious fumes, gases or dust, or to avoidable risk of occupational diseases or accidents; and that self-respecting and desirable labor—labor of the efficient class—can not be secured and retained unless the sanitary arrangements, wash-rooms, lockers, etc., are installed and kept clean and respectable. It seems clear further that there may be special cases where it is the employer's duty to make far-reaching provision for necessaries and comforts of life which the employee is unable to control. Under average American conditions, it has generally proved best for the stability of relations between employer and employee to rest content with sufficient and decent provision for the conditions immediately connected with the work; and with this to provide a mode and scale of payment enabling the employee to realize the largest earnings possible to his individual capacity.

A Real Industrial Leader.

IN the death of Fayette Brown, which was lately noted in the engineering and daily press with universal expression of respect, America lost one of the great characteristic figures in her industrial development. The work with which he was identified was peculiarly typical of American methods—original in conception, vast in its performance, justifying the boldness of its sponsors by hitherto undreamed of success. It was largely instrumental in developing huge natural resources as the foundation of industries such as the world elsewhere had not seen.

Fayette Brown's genius was that of the wise master of business, the successful developer of mechanical industries to the point of conspicuous commercial success. In those qualities, without which the technician is so often helpless or ineffective, Fayette Brown stood conspicuous among the industrial leaders of the world.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

VACUUM IN STEAM TURBINE CENTRAL STATIONS.

AN INVESTIGATION AS TO THE MOST ECONOMICAL VACUUM IN ELECTRIC POWER STATIONS EMPLOYING STEAM TURBINES AND COOLING TOWERS.

R. M. Neilson—Institution of Electrical Engineers.

AN investigation of the effect of vacuum on the first cost and cost of operation and maintenance of steam-turbine central stations equipped with cooling towers has been made by Mr. R. M. Neilson; his recent paper before the Glasgow Section of the Institution of Electrical Engineers is a striking illustration of the attention to the smaller refinements and economies in power-station design and management now demanded of electricity-supply companies by the stress of competition. Mr. Neilson remarks that the advantage of high vacuum in steam-turbine practice is a matter of common knowledge, and that the determination of the best vacuum at which to run a station or a unit already installed is a comparatively simple problem. The case is different, however, when the most economical vacuum has to be determined for a new station or for an extension to an existing station. This problem requires first a decision as to what items in plant cost and in annual expenditure are affected by the vacuum. Mr. Neilson limits his investigation to the effect of vacuum on the initial cost of boiler and condenser plant, and, among the annual charges, to the cost of coal. While he mentions the cost of oil, of condenser water, of cooling towers, and of ground and buildings as slightly affected by the vacuum, the effects, he says, are so small as to be negligible.

"A station has been considered in which the main units consist of three steam turbo-alternators, each rated at 3,000 kilowatts, but capable of carrying a considerable overload, although working most economically at or near their rated capacity. Water-tube boilers are assumed, and surface condensers and electrically driven condenser auxiliaries. The condensing water is assumed to be cooled in natural-draft cooling towers and repeatedly used, the small loss in each cycle being continually made good.

"Considering in the first place a plant load factor of 10 per cent., * Figure 1, curve B, shows how the vacuum affects the cost for interest, depreciation, repairs, maintenance, rates, taxes, and insurance on the boiler plant. The cost itself is not given, but only the difference between the cost at any vacuum and that at 27-inch vacuum.† As the vacuum provided for in the design of the station rises from 25 inches, the estimated steam consumption per kilowatt-hour of the turbo-generators can be reduced, and hence the necessary boiler capacity falls; but, at high vacuum, the power consumption of the condenser auxiliaries rises, and at an increasing rate, so as

* By this is meant that the total B. T. U. of electricity annually delivered from the station—*i. e.*, the gross output of the generators minus the amount consumed in the working of the station—is 10 per cent. of 9,000 × 24 × 365.

† The vacua mentioned in this paper always refer to a 30-inch barometer.

ultimately to overweigh the increasing economy of the turbo-generator; and the steam consumption per B. T. U.* of electricity delivered† from the station rises, so causing an increase in the initial cost

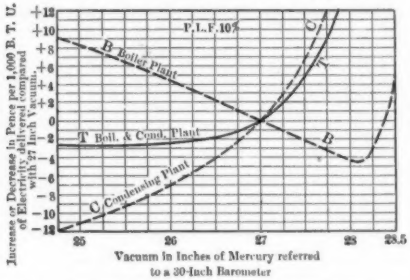

P. L. F. 10%
B Boiler Plant
T Boil. & Cond. Plant
C Condensing Plant
Increase or Decrease in Pence per 1,000 B. T. U. of Electricity delivered compared with 27 Inch Vacuum.
Vacuum in Inches of Mercury referred to a 30-Inch Barometer

FIG. 1. EFFECT OF VACUUM AS REGARDS INTEREST, DEPRECIATION, MAINTENANCE, RATES, TAXES, AND INSURANCE ON BOILER AND CONDENSING PLANT. PLANT LOAD FACTOR, 10 PER CENT.

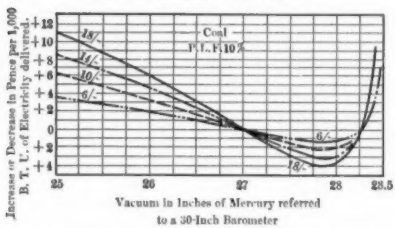

Coal
P. L. F. 10%
18/
14/
10/
6/
Increase or Decrease in Pence per 1,000 B. T. U. of Electricity delivered.
Vacuum in Inches of Mercury referred to a 30-Inch Barometer

FIG. 2. EFFECT OF VACUUM AS REGARDS COST OF COAL, PLANT LOAD FACTOR, 10 PER CENT.
The cost of coal in shillings per ton of 2,240 pounds and of a thermal value of 13,000 B. Th. U. per pound is indicated on the curves.

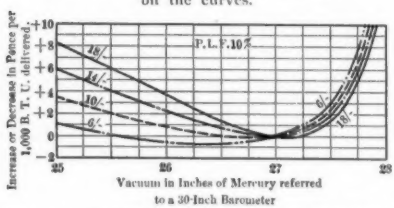

P. L. F. 10%
18/
14/
10/
6/
Increase or Decrease in Pence per 1,000 B. T. U. delivered.
Vacuum in Inches of Mercury referred to a 30-Inch Barometer

FIG. 3. SHOWING THE MOST ECONOMICAL VACUUM FOR A PLANT LOAD FACTOR OF 10 PER CENT.

of the boiler plant. The boiler plant curve is, therefore, as shown in curve B in Figure 1. Curve C, Figure 1, is of the same nature as B, but refers to the condensing plant. This curve rises at an increasing rate as the vacuum provided for goes up. Curve T, in Figure 1, is obtained by taking the algebraic sum of the ordinates in curves, B and C, and shows what would be the most economical vacuum for which to design the station if there were no charge for coal.

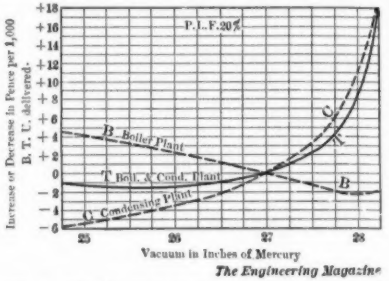

P. L. F. 20%
B Boiler Plant
T Boil. & Cond. Plant
C Condensing Plant
Increase or Decrease in Pence per 1,000 B. T. U. delivered.
Vacuum in Inches of Mercury
The Engineering Magazine

FIG. 4. EFFECT OF VACUUM AS REGARDS INTEREST, DEPRECIATION, MAINTENANCE, RATES, TAXES, AND INSURANCE ON BOILER AND CONDENSING PLANT. PLANT LOAD FACTOR, 20 PER CENT.

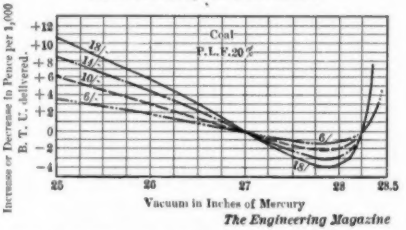


FIG. 5. EFFECT OF VACUUM AS REGARDS COST OF COAL, PLANT LOAD FACTOR, 20 PER CENT.
The cost of coal in shillings per ton of 2,240 pounds and of a thermal value of 13,000 B. Th. U. per pound is indicated on the curves.

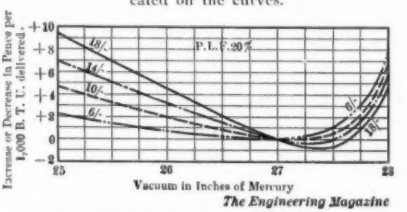


FIG. 6. SHOWING THE MOST ECONOMICAL VACUUM FOR A PLANT LOAD FACTOR OF 20 PER CENT.

"Figure 2 expresses the cost of coal per B. T. U. of electricity delivered, according to the price of coal per ton. The numerals on the curves represent the cost of the coal in shillings per ton. Remarks are made later as to the thermal value of the coal.

* B. T. U. = Board of Trade Unit. B. Th. U. = British Thermal Unit.
† The net output after deducing the power consumed in running the station.

"By combining Figure 1 with Figure 2 we obtain Figure 3, which shows the aggregate variation in the items which vary with the vacuum, and the most economical vacuum is seen to be at about 26¼ inches for coal at 6s. a ton, and at between 27 inches and 27¼ inches for coal at 18s., intermediate prices of coal giving intermediate best vacua.

"Figures 4 to 6 are of the same nature as Figures 1 to 3, but refer to a plant load factor of 20 per cent. The relative importance of low first cost is much less in this case than in the previous, a fact which, of course, will be recognised, and can be seen by comparing curves B and C in Figure 1 with the corresponding curves in Figure 4. The coal, therefore, controls the final result to a greater extent in this case than in the other, and the best vacuum is seen to vary from about 26¾ inches with coal at 6s. to between 27¼ inches and 27½ inches with coal at 18s."

Similar curves for a plant load factor of 30 per cent. show a final result only slightly different from that with 20 per cent. load factor. "The difference between 30 and 40 per cent. would be still less; in fact, each successive increase of 10 per cent. in plant load factor makes a continually less difference in the most economical vacuum. The differences are, in fact, approximately proportional to the differences between the quotients obtained by dividing 100 by 10, 20, 30, 40, etc. If, however, the best vacuum should be required for a plant load factor of, say, 5 per cent., new curves should be prepared, as the difference between 5 and 10 per cent. is about twice as great as that between 10 and 20 per cent. The best vacuum for a plant load factor of 5 per cent. has not been worked out by the author on the same basis as for the other plant load factors, but it would lie between 25½ inches and 27 inches, according to the price of coal. It may be said that, unless in very exceptional cases, the most economical vacuum for any plant load factor and any price of coal will never fall below 25 inches, and never rise as high as 27¾ inches. It must be remembered that this applies only to stations taking their condensing water from cooling towers. . .

"As regards the method adopted by the author to obtain data for his curves, his plan has involved assuming an initial cost for boiler plant and condensing plant, in both cases for 27-inch vacuum. He has then made an assumption as to the variation in the steam consumption of the turbo-generators with varying vacuum, and thus, allowing for the varying power consumption of the condenser auxiliaries, and the varying hot-well temperature, he has obtained the increase or decrease in the boiler-plant cost consistent with the varying aggregate of B. Th. U. required to be given to the water per B. T. U. of electricity delivered. The percentage variation in the cost of the condensing plant with varying vacuum has also been worked out.

"The depreciation, repairs, and maintenance on the boiler plant have been taken at 10 per cent., and the same figure has been assumed as a mean on the condensing plant, including the cooling tower. Seven per cent. additional has been added in each case for interest, rates, etc., so that the total annual charge on boiler and condensing plant is 17 per cent. of the initial cost, which includes cost of erection.

"Different coal consumptions per B. T. U. delivered have been assumed for the three plant load factors, in each case for 27-inch vacuum, and the variation in the coal consumption with variation in vacuum has been worked out. Then, taking four different prices for coal, the difference in cost of coal per 1,000 B. T. U. of electricity delivered has been calculated. The coal has been reckoned as of a uniform calorific value of 13,000 B. Th. U., so that for coal of a greater or less calorific value a correction must be made.* The prices of boiler and condensing plants vary to a certain extent, but it can be proved by trial that an alteration of even 10 per cent. in the prices assumed will be hardly noticeable in the final curves (Figures 3 and 6); only the variation in

* It is usually sufficient in this matter to take the real value of the coal to the power station as equivalent to the thermal value, so that coal of, say, 11,700 B. Th. U. at, say, 9s. a ton, may be taken as the equivalent of coal of 13,000 B. Th. U. at 10s. a ton.

cost—not the total cost—has been used in preparing the curves.

"An opportunity for a slight difference between the best vacuum as indicated by the curves and the actual best vacuum in some particular cases has reference to the variation in the steam consumption of the turbo-generators with variation in vacuum. The author's curves are based on what is believed to be an average variation of steam consumption with vacuum; but the variation is not the same in all cases. It depends on the type of turbine employed, the connection between the turbine and the condenser, and the provision made for utilizing high vacuum in the design of the turbine. The three points are to a certain extent mutually involved, and much could be written on the subject; but this is outside the scope of the present paper. Suffice it to say that the type, design, and arrangements of turbines do not so greatly influence the effect of vacuum on steam consumption below 27½ inches as above this figure, so that the points of maximum sag in the curves in Figures 3 and 6 are not so much affected as if these points had occurred more to the right."

The method of ascertaining the effect of vacuum on the cost of coal and boiler plant is explained in a series of detailed tables, and a brief summary is given of the method of determining the effect of vacuum on the cost of condenser plant. "The boiler plant includes boilers, superheaters, feed-water heaters, feed pumps, water pipes, steam piping and appliances for dealing with the coal and ash; the cost of these, including erection, has been taken as £3.5 per kilowatt for 27 inches vacuum. The condensing plant includes surface condensers, air pumps, circulating water pumps, natural-draft cooling towers and all circulating water piping; the aggregate cost of these items has been taken as £1.4 per kilowatt for 27 inches vacuum." In the tables the steam consumption at full load per unit generated is taken as 18.1 pounds at 27 inches vacuum, and as 20 pounds for the mean of the varying loads.

"The present investigation is based, as already mentioned, on a station containing three turbo-generators each of 3,000 kilowatts, but a considerable variation could, the author considers, be made in the aggregate power of the station and in the number of units installed without greatly affecting the locality of the most economical vacuum for the different plant load factors and prices of coal. The results may, however, be considerably different for stations not dependent on cooling towers, but obtaining cold condensing water from a river, lake, canal, or from the sea."

BAKELITE, A NEW INSULATING MATERIAL.

A BRIEF REVIEW OF ITS MANUFACTURE, PROPERTIES, AND INDUSTRIAL APPLICATIONS.

Dr. Leo H. Baekeland—Journal of the Franklin Institute.

CHEMICAL reactions between formaldehyde and phenol produce under various conditions materials very unlike in chemical and physical properties. Some of these so-called condensation products are soluble in water, some are crystalline, others are amorphous and resin-like. Dr. Leo H. Baekeland has discovered a material of the amorphous type which promises to have many applications in various industries. It is chemically inert and insoluble in all but the strongest solvents. In the solid state it resembles amber in appearance, and when used in combination with wood, paper, asbestos, graphite and other substances it forms a solid, infusible, non-inflammable material of high dielectric strength, resembling in some of its properties hard rubber. Dr. Baekeland has discussed the manufacture, properties and applications of the material, to which the name "bakelite" has been given, in a recent paper before the Franklin Institute, which is published in the *Journal* for January.

The preparation of bakelite may be carried on in one or in several stages, each stage furnishing a product having distinct properties. Ordinarily three

stages of transformation are employed, which produce materials designated, respectively, bakelite *A*, bakelite *B*, and bakelite *C*. The production of the condensation products *A* and *B*, and their ultimate transformation into *C*, constitute the bakelite process.

Bakelite *A* is prepared by heating gently a mixture of approximately equal quantities of phenol and formaldehyde and a small quantity of an alkaline condensing agent. The condensing agents best adapted to the reaction are alkaline salts, or salts which in hydrolizing split up into weak acids and strong bases, such as sodium acetate, the alkaline carbonates, borax, sodium sulphite, etc. The mixture separates into two layers, the upper a supernatant aqueous solution, and the lower a layer of heavy liquid, which is bakelite *A*. By varying the length of time during which the reaction is allowed to proceed, bakelite *A* may be produced as a thin liquid, a viscous, pasty mass, or even as a solid. It is soluble in alcohol, acetone, phenol, glycerine and similar solvents, and also in sodium hydroxide. Solid *A* is very brittle and melts if heated. All varieties of *A* heated long enough under suitable conditions will change first into *B* and finally into *C*.

B is solid at all temperatures, brittle and somewhat harder than *A* at ordinary temperatures. It is insoluble in all solvents but may swell in acetone or phenol without entering into complete solution. When heated it does not melt but becomes soft and elastic like rubber, and on cooling it again becomes hard and brittle. Although infusible, bakelite *B* can be moulded under pressure in a hot mold to a homogeneous coherent mass which can be further changed to *C* by the proper application of heat.

"*C* is infusible in all solvents, unattacked by acetone, indifferent to ordinary acids or to alkaline solutions and yields only to the action of boiling concentrated sulphuric acid and to nitric acid. It does not seriously soften if heated and the temperature may with safety be raised to 300 degrees C. At much higher temperature it chars without entering into fusion. Bakelite *C* is an excellent insulator both of heat and electricity and has a specific gravity of about 1.25. It is very hard and cannot be scratched with the finger nail. In this respect it is far superior to shellac or even to hard rubber and celluloid, but it lacks the great elasticity and flexibility of hard rubber and celluloid. This is its most serious drawback.

"Bakelite *A* heated above 100 degrees C. without any precaution produces a spongy mass of *C* due to the evolution of gases from the decomposition of the condensation product. This is entirely avoided by heating the product in a bakelizer, a closed vessel subjected to an air pressure of 50, or, better, 100, pounds per square inch, and a solid homogeneous mass of bakelite *C* of the exact shape of the recipient is assured. Instead of pouring liquid *A* into a mould to form an object of the desired shape of solid bakelite, it may be applied as a coating to an object of different material, such as wood, which, after treatment in a bakelizer, acquires a hard, brilliant coat of bakelite, superior to any varnish or the most expensive Japanese lacquer. Better still, by using a more liquid form of *A*, soft wood may be impregnated with it, resulting, after bakelizing, in the equivalent of a very hard wood, proof against dry rot, dilute acids, water, and steam. Indeed, in this application to the transformation of cheap soft woods into a material having the properties of the most expensive hard wood, the process promises most fruitful results.

"As a binder for all inert filling materials such as sawdust, wood pulp, asbestos, bakelite has a wide field of application. Among the more impressive applications of this class may be mentioned its use in the manufacture of grindstones and again in the manufacture of oilless bearings of which the aggregate is graphite. Mixed with fine sand or slate dust it can be applied in the form of dough to the inside of metallic pipes, containers or pumps, which, after bakelizing, produces an acid-proof lining very useful in chemical engineering. Among other applications may be named steam- and acid-proof valves and steam

packings, phonograph records and the thousand and one other articles of domestic and industrial utility now made of hard rubber, celluloid or kindred substances.

"In the electrical industry bakelite has already received the test of some actual use. There too its possible applications are numerous. Armatures and field coils of dynamos and motors instead of being treated with ordinary resinous varnishes can be impregnated with *A*, which, treated in a bakelizer, becomes a solid, infusible, insulating mass. This may ultimately permit an increase of the allowable overload in motors and dynamos by eliminating the possibility of melting or softening of such insulating varnishes as are now used. This part of the subject has not, as yet, received more than preliminary investigation, and, for the present, may be dismissed for a consideration of what has already been achieved in the production of moulded insulators, which have been manufactured successfully for several months.

"The element of time is a most important feature in moulding operations. To insure economy of manufacture, the moulds, whose first cost is generally high, must remain in use not longer than a determinate time for each piece moulded. For that reason the methods that are employed require the use of the mould for the very minimum of time. As stated above, the use of bases permits the production of a variety of *A* that is solid though still fusible. This is as brittle as ordinary resin and can be pulverized and mixed with suitable filling materials. A mixture of this kind is introduced in a mould and subjected to pressure at a temperature ranging from 160 to 200 degrees C. The bakelite *A* melts, impregnating the filler, and at the same time is rapidly transformed into bakelite *B*. The latter, as has been noted, is infusible, and the object moulded can therefore be expelled from the mould without changing its form after a very short time and the mould can now be refilled. The moulded articles, now in condition *B*, may at any convenient time be placed in the bakelizer without the use of any moulds and finally transformed into bakelite *C* of maximum strength, hardness and resisting power.

"For electric insulators which are subjected to high temperatures, mineral fillers, such as finely ground asbestos, clay or mica, should be used. If the temperature specifications are not important, organic fillers, like wood pulp or ground sawdust, are available and furnish suitable moulding compositions of which the insulating coefficient is frequently higher than that of asbestos. Not enough experience has yet been gathered to determine the relative merits of porcelain and bakelite-asbestos or bakelite-mica insulators for high-voltage insulation. But for insulation in third-rail systems where the vibration of passing trains is very destructive to the porcelain, bakelite-asbestos has indicated decided superiority after several months of continuous service as well as in direct laboratory tests. Besides greater strength it has shown more regularity in manufacture and allows more accurate moulding, permitting close designs with a smaller margin of safety. It has the further merit that there is no difficulty whatever in imbedding metallic parts like bolts, cores, screws, washers or reinforcing members in the moulded mass."

In comparative tests, a square tube of bakelite, 0.103 inch thick, carried on supports 6 inches apart, has shown a transverse strength of 1,850 pounds, 150 pounds higher than a similar tube of hard rubber-asbestos composition. Bakelite rail insulators have shown ultimate strengths of 96,000 to 110,000 pounds in compression, and 3,200 to 5,500 pounds in tension; the corresponding figures for porcelain insulators are 45,000 to 85,000 pounds and 1,400 to 2,300 pounds. In an impact test under which porcelain failed after 38 to 100 blows, no limit was found for bakelite. As regards the effect of heat on bakelite, an hour's treatment of a valve lining with steam at 460 degrees F. and 265 pounds pressure had no effect on the composition.

Electrical tests have been made on bakelite-asbestos insulation, containing about twice as much finely ground asbestos as bakelite. A spool punctured at

16,000 to 18,000 volts; a similar spool of hard rubber-asbestos composition punctured at 4,000 to 8,000 volts. A square tube, 0.103 inch thick, punctured at 21,000 volts, while a rubber-asbestos tube broke down at 17,000 volts. The puncturing tensions for bakelite-asbestos and rubber-asbestos washers 0.062 inch thick were, respectively, 20,000 and 11,000 volts, and for discs of the two materials 0.095 inch thick, 18,000 and 1,500 volts. A bakelite-asbestos cup insulator 0.375 inch thick punctured at 42,500 volts, and in a test of a line insulator an arc to the pin occurred at 50,000 volts. With bakelite-asbestos rail insulators an arc over the hook bolt to the rail occurs at about 27,000 volts, and with porcelain at about 26,400 volts. The resistance of bakelite rail insulators dry is 5,625 megohms, and wet, 0.5 to 65 megohms; the corresponding figures for porcelain insulators are 4,550 megohms and 0.2 to 10 megohms, respectively.

STREET LIGHTING.

A CRITICISM OF AMERICAN METHODS IN THE ILLUMINATION OF STREETS.

Dr. Louis Bell—American Society of Municipal Improvements.

IN a short paper read before the American Society of Municipal Improvements at the recent annual convention, Dr. Louis Bell makes some pointed criticisms of American methods in the illumination of streets. Like Ajax, he cries for "more light," but his criticisms are not confined to the quantity of light provided in the streets of American cities. His chief complaint is that it is disposed and distributed with little or no regard for the various requirements of different classes of streets, and that the standards adopted in most cities place a premium on inefficiency.

The fundamental criticism against most attempts at street lighting, he says, lies not in the illuminants used, nor in their application, so much as in an improper adjustment of the illumination to the needs of the city. Street lighting, like all growths, has proceeded to a certain extent along the lines of least resistance. The fault particularly noticeable in American cities is the lack of careful discrimination between streets which demand considerable light and those which are perfectly well illuminated with a less quantity of light. Instead of the approximation to uniformity over the whole area of the city which is aimed at in most lighting schemes, there should be a very careful adjustment of the resources of the city in the matter of lighting, so as to facilitate the greatest possible amount of evening traffic. In streets which are largely used during the evening illumination commensurate with their importance should be used, but for streets where the night traffic is light, and where passers-by are few, only light enough is needed to enable the people to get about comfortably. There is still a third class of street which needs individual treatment, the suburban road which still comes within the province of the municipality to illuminate. Funds are seldom available for providing anything like serious illumination for streets of this class, but a great deal for the convenience of the public can be done.

The fundamental purpose of lamps in these outlying, little-used streets, which yet need some light, is merely to serve as markers of the way. Illumination of the first order is unnecessary, and that of the second order needlessly great. In such places the somewhat common practice of using very large units widely spaced is obviously improper. Where a lamp is used merely as a marker to show the way and a general illumination cannot be undertaken, the best thing is to employ small units and locate them so as to get the best results obtainable from the energy in whatever way it may be applied.

In American practice the three classes of streets mentioned above run into each other by such gradual transitions as to indicate very little idea of the lighting requirements on the part of the designers of the illumination. The principal streets of American cities, as a rule, are really poorly lighted, the secondary streets not

particularly well lighted, sometimes better and sometimes worse than they should be, and the streets of the third class frequently have one lamp every long block, useless for practical purposes except within a very short radius and utterly failing in the proper marking of the way. As to the absolute amount of light required, one would not go far wrong in following the principle that in the principal streets, where traffic is constantly heavy, one should have enough light to read a paper by. This is the standard of illumination adopted for the principal streets of the large cities of England and Continental Europe. In London, for example, the illumination of the principal streets averages about one-quarter of a foot-candle. In American cities the average is ordinarily one-tenth to one-twentieth. The secondary streets in London use about the same value of illumination as the ordinary streets in American cities. The streets of the third class are lighted perhaps half as much as the secondary streets, but the light is invariably secured by the use of comparatively small units.

Whatever the intensity adopted, it is desirable to have a fairly uniform distribution. It is not desirable to attain to uniformity at the expense of low maxima but it is equally undesirable to scatter lamps so that there shall be a great deal of light at certain points separated by long stretches of comparative darkness. The light should be diffused so as to make it as useful as possible. The use of diffusing globes is practically universal except in the United States, and largely for this reason street lighting is less uniform in the United States than in almost any other country. Merely, if for no other reason, because the light is not diffused, the illuminants themselves are of a different character. They are intensely brilliant, and have certain dazzling effects which decrease largely the practical usefulness of the light.

In light distribution it is, of course, possible to sacrifice too much for the sake of uniformity. A street may be lighted uniformly and yet badly; it may have a fairly good minimum and yet be improperly illuminated for the purposes of a chief street. It is impossible to judge the efficiency of illumination by the minimum in the street or by the average as seen along the street. Illumination is a practical matter and not a mere theoretical matter of so many hundredths of a foot-candle. It does not take an expert to see whether a street is badly lighted, neither does it take illuminometer measurements to show that improvements are necessary.

The method commonly employed in the United States for measuring street illumination is responsible for a good deal of bad street lighting. The usual method is to measure the light half way between the lamps with the photometer disc, or other measuring instrument, held normal to the ray. The tendency of competition is to secure the minimum specified at as low a maximum as possible. Certain types of illuminants have been deliberately specialized for the purpose of giving two-hundredths or three-hundredths of a foot-candle at a distant point. If these illuminants had been designed, not to give a special form of illumination, but to give the best efficiency of which they were capable, it would be possible to make them light not only the distant parts of the street but the whole street. There are many cases in which the improper method of measuring street illumination causes efficiency to be deliberately sacrificed for the sake of what is nothing more nor less than bad distribution. Foreign practice in measurement is to measure the illumination as it falls on a plane four feet above the ground, measuring on the horizontal, and thus measuring the resolved component. One-tenth of a foot-candle so measured very obviously means a great deal more than the tenth which is obtained on the normal measurement.

To sum up, Dr. Bell concludes, the important things of the future in street lighting is a recognition of the fact that streets are lighted for the people to use, that streets should be lighted with reference to the use which is going to be made of them, and that, on the whole, they should be much more brilliantly lighted than is customary in the United States to-day.

GROUND WATERS AS PUBLIC SUPPLIES.

AN EXAMINATION OF GROUND WATERS OBTAINED FROM SHALLOW WELLS AS SOURCES OF PUBLIC WATER SUPPLIES.

William S. Johnson—New England Water Works Association.

A REACTION against the ignorant distrust of ground waters in general as sources of public water supplies which followed the discovery half a century ago that water might be the cause of typhoid-fever epidemics in localities served by wells has accompanied the gradual growth of knowledge as to the relative purity of surface and underground supplies. Ground waters drawn from properly located wells are now known to be far safer than the waters of even mountain brooks, the most attractive of surface supplies, and the opinion is steadily gaining ground that the waters of no surface source are safe to use without purification. The return to favor of ground waters is well illustrated by the records of public supplies in Massachusetts. In 1879 only 8 or 12 per cent of the towns supplied with water from public sources were supplied from ground-water sources. By 1889 the percentage had reached 31, by 1899 it had reached 38, and now 41 per cent of the cities and towns supplied with water obtain it from ground-water sources.

An interesting paper on ground waters as sources of public water supplies, read by William S. Johnson before the New England Water Works Association in November last, is published in the *Journal* for December, 1909. Ground-water supplies, he says, may be divided into those obtained from deep wells, or so-called artesian wells, and those obtained from shallow wells, either driven or dug, or from filter galleries located near some surface source. Artesian wells he dismisses with brief consideration. They have very seldom proved successful in New England. The most common failure has been due to the small quantity of water obtainable, but when a large volume of water has been found in deep wells it has generally been of poor quality. Under the conditions existing in New England, to which Mr. Johnson's remarks on deep-well supplies apply, the most satisfactory water supplies are those which are obtained from shallow wells or from filter galleries, the water from which is obtained either from the ground in the immediate vicinity or from some nearby surface source.

The chief reasons why ground-water supplies are more satisfactory than surface sources for public water-supply purposes are, first, their low temperature in summer; second, their attractive appearance and freedom from color, taste and odor; and third, the greater safety in their use. The temperature of water obtained from the ground at the depth from which the supplies are ordinarily obtained is from 48 to 52 degrees, unless the water is affected to a considerable extent by the infiltration of surface water, and this temperature is maintained throughout the year. Since ground waters cannot be stored in reservoirs exposed to the sunlight, on account of the growth of organisms under these conditions, the supplies reach the consumers at a temperature which does not rise above 60 degrees even during the warmest days of summer and the water is never warm enough to be unpalatable. Surface waters, on the other hand, are frequently delivered at a temperature of about 80 degrees.

A good ground water is always clear, practically colorless, odorless and tasteless, while almost all surface waters are colored and are subject at times to disagreeable odors and tastes. The waters taken from mountain streams without being stored are the best of the surface waters in regard to color and odor, but these are very likely to be turbid at times of storm or of melting snow. It must be admitted that many ground waters have color, and some of them a very high color, but these are not normal ground waters, being affected in each case either by iron or by infiltration from some surface source.

Ground waters are superior to surface supplies principally because of the comparative safety which attends their use. If the source of supply is properly located, even if the water has at some time been polluted, the danger in its use is reduced to a minimum. Except under extraordinary conditions it is almost impossible for disease germs to survive the purifying effect of the slow passage of ground waters through the soil. Pollution of even the most attractive of surface water supplies, on the other hand, may occur in innumerable ways, even with the most careful supervision of the source and its watershed and of storage reservoirs. Water taken from sand or gravel beneath the surface of the ground is generally absolutely free from the organic matter from animals and from decaying vegetable matter usually found in surface supplies.

The objectionable or troublesome features of ground waters are, first, the uncertainty which must exist as to the quantity of water available; second, the conditions which favor the growth of organisms in the water; third, the possibility of the presence of iron; and fourth, the possible deterioration of the water with long-continued use. The uncertainty as to the quantity of water is one which can be met only by making thorough tests. The dry-season supply of a surface-water source it is possible to foretell with considerable accuracy. In the case of a ground-water supply it is impossible, even with as thorough a knowledge of the soil as it is feasible to obtain, to foretell the quantity of water obtainable. It has become the custom in the more important investigations of ground-water sources to make a pumping test to assist in determining both the probable quantity and the probable quality of the water to be obtained. With the information furnished by the pumping test, especially if the test is conducted during a period when the ground waters are at a low level, it is possible to make a sufficiently close approximation of the quantity of water available.

Ground waters, when exposed to light for a considerable time, are almost certain to contain growths of organisms, which, when they decay, will cause the water to be very objectionable. Ground waters stored in open reservoirs are affected by growths of organisms during the summer months to such an extent that the water can hardly be used for domestic purposes. The employment of covered reservoirs in cases where it is necessary to store ground waters removes this difficulty and at the same time preserves the low temperature of the water.

Nothing causes so much complaint or trouble with a water supply as the presence of iron and most of the troubles which have occurred with ground-water supplies have been due to this cause. Iron occurring in water in any form causes rust spots on clothes washed in it, imparts to the water a color and an objectionable odor and taste, fills up service pipes, and clogs up wells. In general, the presence of iron is due to the imperfect filtration of water containing organic matter. Water obtained from a well sunk in a swamp where there is no impervious layer between the peat and the water-bearing stratum is almost invariably affected by iron. Water obtained from a well located close to a stream is likely to be affected by iron after long-continued draft from the well at a rate considerably greater than the rate at which water is flowing toward the well from the land side, since the filtration becomes less perfect as more water is drawn from the surface source. In many cases wells sunk to tap ground-water supplies before the causes of the presence of iron in water were properly understood have had to be abandoned; in other cases filtration has been adopted.

Many ground-water supplies deteriorate on account of a slow increase in the amount of iron in the water. In most cases this deterioration accompanies increase in the draft from the wells, and in some cases it is due to the extension of the area from which the water is drawn to the collecting works. Occasionally it can be foretold that the water will contain iron, and sometimes samples drawn from the test wells with a hand pump will show iron. In other cases the entire absence of iron

may be predicted with reasonable certainty, but the only safe way, before installing a new supply, is to conduct a pumping test, making frequent chemical examinations of the water.

A pumping test consists in drawing water continuously from the ground at a rate at least as great as it will be drawn after the works have been constructed and are in general use. During the test careful measurements should be made of the quantity of water pumped, generally by means of a weir, and at the same time measurements of the height of water in the ground should be made frequently by means of open test wells located at different places within and around the area from which water is being drawn. The duration of the test should be governed by the results obtained. If the general level of the water in the ground continues to fall rapidly, indicating that the water stored in the ground is still being drawn upon, the test should be continued. If, however, the level of the water becomes practically stationary and the analyses show no deterioration in quality, a test of one or two weeks may be sufficient. After the pumps are stopped, frequent readings should be made of the height of the water in the test wells to show the recovery of the water level. When the test results are intelligently interpreted a very accurate prediction can be made of the quantity and of the quality of the water to be obtained from the source.

While surface indications do not furnish absolutely trustworthy evidence of what may be found beneath the surface, they are of sufficient value to warrant careful study before any test wells are driven. The sources of water in shallow wells are the rainfall upon the ground in the vicinity of the well, and water which may percolate towards the source from neighboring surface water; rainfall is more likely to be unpolluted and less subject to deterioration from increasing draft. The amount of water entering the ground depends upon the contour of the surface and the character of the soil. Less water enters the ground on steep slopes than on comparatively flat land, and little water can penetrate a compact and impervious stratum. The most favorable condition, therefore, for obtaining water from the ground is a flat area of sandy or gravelly land, and when this condition is found, good wells can usually be developed some place in the vicinity. In general, ground waters flow in the direction of the surface slopes, and the best place to obtain the ground waters is likely to be in some valley. Wet land, except when at about the level of the water in a neighboring stream or pool, indicates an impervious stratum and is not a favorable indication. Swamp areas, or areas containing a considerable deposit of peaty matter which is wet most of the time, should be regarded with very great suspicion. They almost invariably affect the quality of the water in wells located near them, unless the swamp is wholly underlain by an impervious stratum.

When, as is usual, the ground-water source is located in a valley near a stream or pond, a considerable proportion of the water, depending chiefly on the rate at which water is drawn, is obtained from the surface source. Water obtained by infiltration from a surface source is satisfactory if conditions are such that it is well purified in its passage through the ground, that is, if the organic matter is completely changed over to inorganic. Such water may have some of the color of the surface source, and the temperature may be somewhat higher than that of a ground water not affected by the surface source, but there is no iron and the water is bacterially pure. Recently some successful attempts have been made to increase the yield of ground-water sources by the application of water to the ground in the vicinity of the wells. At Newburyport, Mass., the water from a stream some distance away is pumped on the gravelly soil above the wells and springs from which the supply is drawn. Although the water of the stream is of a very poor quality, containing an enormous amount of organic matter during the summer months, the quality of the filtered water is excellent and the results of the experiment have been satisfactory.

The cost of the preliminary investigation for a ground-water supply is likely to be greatly in excess of the cost of the investigations necessary for the development of a surface source; on the other hand, the cost of construction may be much less. But whatever the cost, the superior quality of the water, and, above all, the safety in its use, should cause the ground-water sources to be thoroughly investigated before determining upon a supply from a surface source, which is certain to be inferior in quality to a ground-water supply.

THE IMPROVEMENT OF INLAND WATERWAYS.

A CONSIDERATION OF THE RELATION BETWEEN RAILWAYS AND WATERWAYS, AND THE IMPROVEMENT OF INLAND NAVIGATION IN THE UNITED STATES.

Report of the United States National Waterways Commission.

THE preliminary report of the United States National Waterways Commission, just published, is a document of great public interest. It is a sane and impartial presentation of the arguments for and against the waterway-improvement schemes which are being agitated with so much vigor, and offers for the first time an authoritative answer to the question "will waterways pay?" In the small space available in these columns it is possible to do little more than indicate the scope of the Commission's inquiry and to summarize a few of the more important of their conclusions. For details we must refer our readers to the full report, which is published verbatim in *Engineering News* for February 3. In the following abstract, we outline the findings of the commission on only three points, the relation between waterway and railway transportation, the practicability of artificial waterways for deep-draft vessels, and the policy of the Government relating to harbor improvements and the ownership and control of wharves and docks.

The report first examines the reasons for the decline of inland waterway transportation contemporaneously with the great increase in railway traffic. In the opinion of the Commission the chief factor in the decrease of water-borne traffic is the relation existing between waterways and railways. The advantages which a railway has in competition with a water route may be divided into two classes. Those inherent or fundamental advantages which depend upon permanent conditions include the wider area of distribution available to railways, the increasing importance of terminals and the necessity for facilities for the prompt and economical handling of freight, the simpler transfer of traffic from one railway to another than from water to rail, and the advantage of higher speed and more regular schedules. The advantages which may be deemed artificial or temporary, due to conditions not necessarily permanent in their nature, are: the right of the railway to charge lower rates between points where their line is in competition with water routes; the power to acquire steamboat lines or to enter into agreements with them for the purpose of stifling water-borne traffic; the refusal of the railways to pro-rate on through routes where naturally freight would be carried part of the way by rail and part by water; and, finally, the far greater attention given by railways to provision for warehouses, terminals and equipment for handling freight.

That the tendency of waterway improvements is to lower railway rates the Commission do not deny, but they cannot indorse the improvement of rivers solely for their effect upon railway rates as a desirable policy to adopt. Argument in favor of this policy rests, in the first instance, upon the transparent fallacy that the railways constitute an intrenched and uncontrollable monopoly which cannot be reached by legislation or other orderly and legal methods; that the only way in which to compel them to lower rates is by the expenditure of large sums of money in the improvement of channels, which are to re-

main wholly or partially unused. National or state legislation is certainly sufficient, and should be resorted to, for securing proper reductions in railway freight rates. Again, the Commission emphasize the principle that the subject of transportation should be considered as a great economic problem. While the tendency of waterway improvements to lower freight rates is an important element to be considered, the fundamental criterion should be whether a railway or waterway, when constructed or improved, will be a profitable investment of capital.

The most essential requirement for the rehabilitation of water traffic is, in the opinion of the Commission, the establishment of harmonious relations between railway and water lines. It is quite as important that there should be co-operation between them as that greater depth of channels should be secured. The fact that in practically every case the boats operated upon water routes which are found to be profitable are operated in connection and in harmony with railway lines indicates that to a certain extent this co-operation already exists. The transportation facilities of the country will be still further promoted by compelling joint rates and prorating agreements, and by requiring through bills of lading and physical connection between rail and water agencies. It is a waste of capital to construct separate systems of warehouses and terminals for railways and waterways when they can be used jointly by both methods of transportation. Legislation, in order to be effective, must require terminal and wharfage charges to be reasonable whether these facilities are owned by railways or waterways.

There are many advocates of legislation which would give the Interstate Commerce Commission the power to prescribe minimum rates for railways, but the Commission can not see its way clear to recommend a general power to fix minimum rates. Such legislation would rest upon the theory that the lowering of rates as a general proposition often operates merely for the benefit of the favored few who are able to take advantage of them, and that, applied to railways, the exercise of such a power would prevent that ruinous competition between rail and water routes which drives the boats off the rivers and canals of the United States. The lowering of the cost of transportation is an important factor in promoting industries and commerce. The general tendency in the United States has been towards lower rates, and any regulation which would directly or indirectly interfere with this tendency would be likely to be injurious rather than beneficial. A majority of the Commission, however, recommend giving to the Interstate Commerce Commission power to prescribe minimum railway rates whenever, in its opinion, the object of a railway in reducing rates is to destroy waterway competition.

The report reminds the advocates of the building of canals of the very great advantages of natural waterways over artificial channels for the purposes of navigation. Natural waterways have stable banks and usually pass through valleys and close to populous cities and towns. Their width allows the development of docks and basins without extra cost for right of way, and for a large portion of the year they allow the passage of boats of unusual draft. Artificial channels may be constructed along a straighter line, but usually with great difficulties in the acquisition of property for their construction, as well as in overcoming difficulties of elevation. Topographical difficulties may cause the route to pass through comparatively uninhabited districts and through regions where development may naturally be slow. Because of the expense, the provision of a width sufficient for the handling of ocean boats is practically impossible, except for comparatively short distances. They may have an advantage in greater freedom from silt and other obstructions to navigation, but this is usually more than counterbalanced by the difficulty of obtaining an adequate water supply.

The Commission has examined the question of the construction of artificial canals adapted to the passage of seagoing vessels. They find that waterways of this class are profitable only

under certain well defined conditions: first, when, like the Sault Ste. Marie Canal, they connect navigable waters located near each other, between which large traffic would naturally exist, except for rapids, a barrier readily overcome, or the existence of a comparatively narrow strip of land; second, when a comparatively short canal will save a great sailing distance, as in the case of the Suez Canal; and third, when they connect with the sea large cities situated near the coast, where communities have grown to large size and become great producers or consumers of freight without connection with the ocean.

Consideration of the remainder of the report must be limited to a summary of the topics dealt with in the various sections. These are: the necessary steps to be taken before the adoption of projects for the improvement of rivers and harbors and the methods of making appropriations therefor; the proper division between appropriations by the Federal Government, on the one hand, and by the states, minor political divisions, and individuals, on the other hand; the relation of waterway improvements to bank protection, flood and drought prevention, irrigation and drainage; policy relating to harbors, including the ownership and control of wharves and docks; the relation of waterway improvements to water power; methods in the improvement of rivers, including the construction of locks and dams; and a comparison of European waterways with those of the United States, including an investigation of European and American transportation rates both by land and water. We may conclude by quoting the findings of the Commission on the question of the improvement of harbors. They applaud the progressive policy of the Government in harbor improvement work, but recommend a division of harbors into classes by depth or by the importance of their ocean or coastwise traffic. They also advise care in avoiding an unnecessary multiplication of ports, and in defining clearly the line to be drawn between the work to be done under appropriations by the Federal Government and that by cities and individual owners. The full duty of the Federal Government, the Commission consider, is to provide for a safe entrance into a bay or harbor sufficient to afford safety to shipping, and suitable anchorage grounds in proximity to cities thereon. The maintenance of minor channels leading to wharves in harbors, and the construction of wharves and docks by the Government, the Commission are unwilling to recommend. In fact, they advise that, in deciding whether a harbor improvement is to be adopted or not, it is wise to omit those cases where there is not assurance that local or private enterprise will furnish all needed terminal facilities.

THE USE OF OZONE IN SANITATION.

A REVIEW OF THE PROPERTIES OF OZONE AS A STERILIZING AND DISINFECTING AGENT.

A. Mabille—The Electrical Review.

THE employment of electrical ozonisers in Europe for the sterilization of drinking water continues steadily to increase. Paris has installed apparatus with a capacity of 10,000,000 gallons per day, and Nice treats 5,000,000 gallons per day. The latest addition to the list of cities employing this method of water purification is St. Petersburg. We have already given in these columns a brief description of the equipment of one of the smaller municipal plants. A more comprehensive discussion of the place of ozone in sanitation is here presented, after an article by A. Mabille in *The Electrical Review* for December 31, 1909.

"The study of ionisation of air and radio-activity may in the near future yield most important results. Dr. Napier Shaw referred to the ionisation of air in his evidence before the Select Committee of the House of Commons, but was not able to give any definite data as to its practical application, while although we now know that rain water

is strongly radio-active (while tap-water is quite inactive) we have but vague ideas at present as to the effect of the electrical and radio-active conditions of air on animal life. Ozone is strongly radio-active. Ozone, an allotrophic modification of oxygen, is produced by the passage of the silent electrical discharge across an air space; if moisture is present, nitric acid and nitrous oxides are also produced, but by keeping the voltage low the production of nitric acid and nitrous oxides is reduced to a negligible quantity, so that the properly-designed modern ozoniser may be said to be quite free as far as nitric acid production is concerned. Air breaks down and allows a brush discharge to take place when the potential gradient exceeds about 18,000 volts per centimetre, ozone being freely produced; nitric acid is not produced unless the voltage is considerably above that required to produce ozone, provided excessive moisture is not present. Most ozonisers work at from 2,500 to 5,000 volts, the two electrodes being about $^{3}/_{16}$ inch apart, with a glass plate in between $^{3}/_{32}$ inch thick, so that the air-space is about $^{3}/_{32}$ inch across. This glass plate between the electrodes (in small ozonisers it usually has an aluminium foil covering pasted on one side to form one electrode), prevents any arcing across, and incidentally also raises the potential drop across the air-gap by reason of the higher specfic inductive capacity of the glass. The violet brush discharge passing over the air-gap converts the oxygen of the air, O_2, into ozone, O_3, provided the condenser plates are kept cool, the conversion ceasing if any considerable temperature rise takes place. In large apparatus the electrodes are usually water-cooled. In the case of a town supply, the air is generally sucked through the battery of ozonisers by means of an air pump, and then driven to a mixing tank or sterilising column, where the water entering at the top in a fine spray, meets the current of ozonised air, and is thoroughly commingled with the same, the water being thus completely sterilised, and ready to be delivered into the town supply reservoir.

"A small domestic apparatus is now on the market, in which the air is sucked through the ozoniser by means of an emulser fixed on the outlet of the water tap, this emulser serving the double purpose of an air pump and ozone mixer. This apparatus will treat 60 gallons of water per hour, and takes approximately 50 watts; the emulser has no moving parts, and cannot, therefore, get out of order. Using a small apparatus of this description, M. Neisser found that with water at a pressure of 30 pounds per square inch, the number of germs was reduced from 43,000 to 2 per cubic centimetre, and that even microbes of the staphylococcus or coli bact. class were instantly killed.

"In the ozone apparatus, the germs are actually killed, whereas in the ordinary mechanical type of filter they are merely held back by the filtering medium, which in time is liable to become very foul and act as an actual breeding place for the microbes. Carbon filters are particularly faulty in this respect, it being essential frequently to sterilise the carbon blocks by heating them—a process that is tedious and is generally neglected by the ordinary householder. Hence these filters are a positive danger in themselves. Ozone possesses both taste and smell, and is thus distinct from oxygen, which has neither. However, the flavour of water treated with ozone is not at all impaired; indeed, the added oxygen appears to give the water a distinctly refreshing taste.

"The sanitary engineer will be more concerned with the disinfecting properties of ozone, as likely to be of help to him in the prevention of 'zymotic' diseases. The pathogenic or disease-producing bacteria consist principally of three groups:—*Micrococci* (more or less spherical in shape), *bacilli* (of rod-like shape), and *spirilla* (which derive their name from their spiral shape), none of which appear able to survive the poisoning action of ozone. This is important, for according to Dr. Koch's experiments, sporeless bacilli are only killed after five minutes' treatment by a 5 per cent. solution of carbolic acid, and are not even injured by a 1 per cent.

solution, while the spore-bearing bacilli will resist a temperature of over 212 degrees F.

"Clearly, therefore, there should be a field for ozone for the flushing and disinfecting of sewers and house drains, especially in view of the fact that ozone destroys sulphuretted hydrogen, and would thus probably be far more effective in dealing with the gas from sewer ventilation pipes than the present method of burning the gas by the use of special gas lamps.

"Air ozonisers have already been extensively used for hospital and sick-room disinfecting, but the use of any form of ozoniser for sewer work has up to the present not been tried. While sea air contains from 3 to 5 per cent. of ozone, the percentage of ozone in sick-room air is, as a rule, very minute indeed, hence the use of air ozonisers for hospitals is now finding considerable favour. The *Lancet*, in May last, advocated the use of the stem drinking glass, owing to the liability of the fingers to touch the brim of the ordinary tumbler; yet the same medical paper totally ignores the far greater risk of infectious disease being spread by reason of the absence of any attempt to sterilise the drinking glasses used in public bars, restaurants, etc. A glass after being used by a person, possibly in the last stages of consumption, is washed in lukewarm water, frequently none to clean, and then used for the next customer without any thought as to whether the glass is germ free or not.

"Much consumption undoubtedly is spread in this way, and the matter is one which the manufacturers of ozone apparatus might find well worthy of close attention. Once the general public have their attention drawn to this point, they will insist on the hospital and restaurant managers using suitable precautions."

THE DANGERS OF FERRO-SILICON.

AN INVESTIGATION OF THE LIBERATION OF POISONOUS AND EXPLOSIVE GASES FROM FERRO-SILICON DURING TRANSPORT.

Iron and Coal Trades Review.

ACCIDENTS attributable to the escape of poisonous and explosive gases from consignments of ferro-silicon have been sufficiently numerous and serious to cause the chief shipping companies to decline to handle further shipments of this material. As a consequence, very little high-grade alloy is finding its way to the English markets, and, as English steel makers are entirely dependent upon Continental manufacturers for ferro-silicon above the ordinary grade produced in the blast furnace, considerable anxiety exists as to how future supplies are to be obtained. A special investigation of the dangers attending the transportation and storage of ferro-silicon has been made for the Local Government Board, and an elaborate report dealing exhaustively with the nature and uses of the alloy has just been issued. A summary of the conclusions and recommendations offered by Dr. S. Monckton Copeman, who had charge of the inquiry, is taken from the *Iron and Coal Trades Review* for January 14.

"Numerous accidents, fatal and otherwise, have been caused within the last few years by the escape of poisonous and explosive gases from consignments of ferro-silicon, which, in every instance, have been found to consist of so-called high-grade ferro-silicon, produced in the electric furnace. These accidents, for the most part, have occurred during transport of the ferro-silicon by water, whether in sea-going vessels or in barges and canal boats plying on inland waters. They have occurred in various countries and on vessels of different nationalities, while the ferro-silicon carried has, in almost every instance, been the product of a different manufactory.

"Ferro-silicon, especially of grades containing from 40 per cent. to 60 per cent. of silicon, is invariably found to evolve considerable quantities of phosphoretted hydrogen gas, and, in less

amount, of arseniureted hydrogen, both of which are of a highly poisonous nature. A certain amount of the gas evolved is present, as such, in the alloy, being 'occluded' in minute spaces with which its substance is often permeated.

"As the result of careful investigation, it has been shown that certain grades of ferro-silicon notably such as contain about 33 per cent., 50 per cent., and 60 per cent. of silicon (corresponding possibly to the formulæ, FeSi, $FeSi_2$, and $FeSi_3$, respectively)—even when manufactured from fairly pure constituents, are both brittle and liable to disintegrate spontaneously, this latter characteristic being apt to be specially marked in the case of the 50 per cent. grade. In the event of disintegration occurring, the amount of surface exposed will, obviously, be greater than if the mass were solid.

"Evolution of poisonous gases is greatly increased by the action of moisture, or of moist air, under the influence of which phosphoretted hydrogen is generated from calcium phosphide, which, in turn, is formed, in large part at any rate, from the calcium phosphate present in anthracite and quartz, at the high temperature of the electric furnace. If spontaneous disintegration of the alloy also occurs, much larger quantities of gas would be given off from such friable and unstable material, other conditions being equal. The greater or less tendency of a given sample to evolve poisonous gases, and even a rough estimate of their probable amount, may be arrived at by the use of test papers prepared with silver nitrate.

"There is no evidence that low-grade ferro-silicon (10 to 15 per cent.), produced in the blast furnace, has ever given rise to accidents of similar character to those known to have been caused by the high-grade electrically-produced alloy. Blast-furnace ferro-silicon does not evolve poisonous gases even in presence of moisture. As regards ferro-silicon produced in the electric furnace, the evidence available goes to show that certain percentage grades are practically quite innocuous. This statement applies to grades of alloy of a silicon content up to and including 30 per cent., and probably also, though in considerably less degree, to those of 70 per cent. and over.

"In view of the fact that the use of ferro-silicon of grades ranging between 30 per cent. and 70 per cent. apparently is not essential in metallurgical operations, with the possible exception of basic steel manufacture, it will be advisable that the production of this alloy of grades ranging between these percentages should be discontinued in the future. The proprietors of iron and steel works making use of ferro-silicon will assist in the protection of their workpeople, and at the same time act for the public benefit, by restricting their orders to grades of this material, either not exceeding 30 per cent., or of 70 per cent. and upwards, according to the special nature of their requirements. But as, pending international agreement on the question, intermediate percentages of ferro-silicon will doubtless continue to be manufactured and sold, the issue of special regulations will be necessary in order to obviate, so far as may be possible, chance of further accidents during the transport of this substance. *Inter alia*, these regulations should require a declaration of the nature, percentage, date of manufacture, and place of origin of any such consignment.

"The precautionary measures proposed in connection with the storage and transport of ferro-silicon are these:—

1. Ferro-silicon should not be sent out from the works immediately after manufacture, but, after being broken up into pieces of the size in which it is usually sold, should be stored under cover, but exposed to the air as completely as possible, for at least a month before being despatched from the works.

2. Manufacturers should be required to mark in bold letters each barrel or other parcel of ferro-silicon with the name and percentage grade (certified by chemical analysis) of the material; the name of the works where it is produced; the date of manufacture; and date of despatch.

3. The carriage of ferro-silicon on vessels carrying passengers should be

prohibited. When carried on cargo boats it should, if circumstances permit, be stored on deck. If it be considered necessary to store it elsewhere, the place of storage should be capable of being adequately ventilated, and such place of storage should be cut off by air-tight bulkheads from the quarters occupied by the crew of the vessel.

4. This regulation should apply to the transport of ferro-silicon on river or canal barges as well as on sea-going vessels.

5. Storage places at docks or at works where ferro-silicon is used should have provision for free access of air, and should be situated at a distance from work-rooms, mess-rooms, offices, etc."

THE FUTURE OF COPPER.

A BRIEF REVIEW OF COPPER PRODUCTION THROUGHOUT THE WORLD AND OF THE POSITION OF THE UNITED STATES.

James Douglas—Mining and Scientific Press.

IN December, 1909, Dr. James Douglas contributed to THE ENGINEERING MAGAZINE a review of the statistical position and probable future of the copper industry in the United States. More recently, in the *Mining and Scientific Press* for January 8, he has discussed the position of the United States among the world's producers of copper. The extracts from the latter article which are given below acquire additional interest by comparison with Mr. C. F. Tolman's consideration of the same subject on another page of this issue.

Great Britain, which during the first half of the last century took the lead as a copper producing country, "can never attain high rank with production on the scale of today, as her mines, besides having been stripped of their richer ores, are included in a limited area of South Devonshire, Wales, and Cornwall, the copper yield of the Wicklow pyrites being negligible. But Chile, Bolivia, and Peru have resources of incalculable extent. Chile's production attained its zenith in the early seventies, when her mines yielded over 50,000 tons. This came almost exclusively from the districts of Tamaya, Carrizal-Alto, and Chañaral, with small quantities of argentiferous copper from the Copiapó. They mined only the richer ore, extracted from comparatively shallow depths. The cost of mining and smelting with dear coal in reverberatory furnaces of small size was high, and has remained so ever since. But Chile's coal mines, in the southern provinces, have of late undergone rapid development; petroleum discoveries on the west coast have been made, and above all, the contagion of our success in working low-grade porphyries will extend, and when it reaches there, low-grade ore will be developed in abundance sufficient to keep both company mongers and metallurgists busy.

"The interior of Bolivia and Peru will not yield their mineral treasures until railroads reach them. The sandstones that have for a century yielded the copper *barrilla* (metallic copper) which has been shipped in small quantities from Arica, after transportation over 200 miles by mule and rail, extend for some 300 miles from Corocoro in Bolivia to San Pedro de Atacama in Chile, will in time duplicate the production of our Lake Superior mines.

"What Peru may do can be imagined from the brilliant results of working the copper ores at Cerro de Pasco which underlie the silver ores of that famous region. Next year the furnaces at Tinyahuarco promise to turn out 60,000,000 pounds of copper.

The production of Mexico, like our own, has grown with the progress of railroad building, and has expanded from less than a thousand tons 30 years ago to over 60,000 tons at present. Canada also owes her position to the assistance of railroads. The maritime Provinces have never produced copper in any quantity, and though the Province of Quebec in the sixth decade of the last century figured more conspicuously in the number of companies organized than

in the quantity of copper produced, she has not maintained her early output. Ontario in the same period appeared as a notable producer of copper from the Bruce mine, on the north shore of Lake Huron, but it was not till the Canadian Pacific cut away from the river and the lakes and opened up the interior that Sudbury was discovered, and subsequently the copper mines of the Boundary District of British Columbia were made accessible. But these discoveries have been made on the mere fringe of a territory which covers half the continent. Twenty-five years ago, before the development of the Sudbury mines, Canada made only about 1,000,000 pounds of copper per annum; last year she made 64,000,000.

"Looking to the other hemisphere, we find even more unexplored and undeveloped territory than in the Western world. The Cape Copper Co., from its mines in Namaqualand, in Cape Colony, has maintained a small but steady yield since its organization in 1888; but both it and the copper mines in the adjacent German territory lie close to the coast. The vast interior of the continent is to the miner almost an unknown land. Some small mines have been opened in South Rhodesia, and we are soon to know whether the promises made of great production from the Tanganyika Concessions, and from the Katanga District of the Congo Free State, are to be realized. Within less than a twelve month a branch of the Cape to Cairo railroad will have been completed." A recent report of the Tanganyika Concessions, Limited, states that within a year their production will reach 2,500 tons a month.

"In Asia are vast areas of unexplored territory, and in Australia old mines are being reopened, where our experience in working low-grade ores will be repeated. Meanwhile it must not be forgotten that we have not opened a large high-grade mine except North Butte since the Iron Mountain, in 1894, and that nearly all our old high-grade mines must now be classed as low-grade. To extract the copper from the new avowedly low-grade deposits, even with improved methods, will cost more than the old standard, and the same will become increasingly true of the working of these same low-grade ores as depth is attained. Percentages will fall off, and all the contingencies which accompany either large surface openings or greater depth must be met; and these contingencies will have to be encountered in the face of a larger foreign production. To successfully overcome these difficulties without losing our standing among the world's producers will require skill, discrimination, business ability, and some moderation in output."

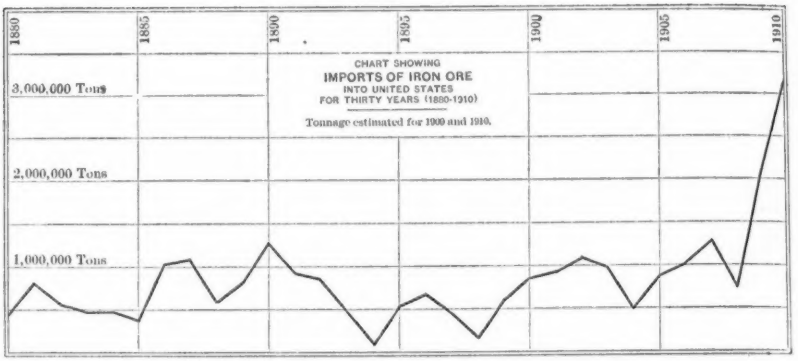
IMPORTS OF IRON ORE INTO THE UNITED STATES.

THE PERSISTENCE OF AN INTERESTING CHANGE IN THE SOURCES OF ORE SUPPLY FOR EASTERN FURNACES.

B. S. Stephenson—Iron Trade Review.

ONE of the most interesting results of the business depression of 1907-8 upon the iron trade of the United States is the radical change which has taken place in the sources of ore supply for the furnaces of Eastern Pennsylvania and New Jersey. The change was made while panic conditions still prevailed and was primarily intended to be only temporary, but it has proved of such material advantage that the importation of foreign ores to supply this district is likely to persist and rapidly to increase. In the *Iron Trade Review* for January 27, Mr. B. S. Stephenson discusses foreign sources of supply and the conditions of importation. The following paragraphs, showing the increase in imports during 1909 and the probable movements during 1910, represent only a small portion of his paper.

"Very little Lake ore was taken by furnaces in Eastern Pennsylvania, and New Jersey during 1909,—although a few bargain lots of slightly inferior analy-



CHARTS SHOWING IMPORTS OF IRON ORE FOR THIRTY YEARS, 1880-1910.

sis were used in the Schuylkill and Lehigh valleys,—and during 1910 there is every indication that this source of ore supply will practically be ignored. To replace the Lake ores in their mixtures, the furnacemen of this district have turned to both foreign and local producing districts to a greater degree than ever before. During 1909 the cost of the cheapest Lake ore available, Mesabi non-Bessemer, delivered at eastern furnaces, averaged 9.6 cents per unit, a prohibitive figure in view of the low prices at which iron sold in this district over a good part of the year. Spanish, Swedish and Wabana (Newfoundland) ores could be imported at fully one cent per unit below this figure and operations in upper New York, New Jersey and Eastern Pennsylvania found a profitable market for their maximum output on about the same basis as the foreign ore. The result was that furnace interests discovered they could depend upon these sources for their entire requirements and as early as July or August began contracting for 1910 delivery of Spanish ores.

"To credit the sharp increase in importations to the tariff reduction from 40 to 15 cents per ton is manifestly erroneous, as in practically all instances this additional profit of one-half cent per unit was appropriated by the seller. How radical has been the change to the foreign field is indicated in the chart, graphically representing the importations of ore over the past 30 years. The tonnages for 1909 are estimated from reports by the leading factors in the trade as to the movement of foreign ores in which they were interested, and probably are considerably in excess of the government importation figures for the year (not yet available), as the difficulty in chartering ore carriers late in the year forced several importing interests to enter 1910 with large tonnages of ore sold for 1909 shipment still undelivered. The figures for 1910 are estimated, based in a large part on contracts already closed or, in the case of Cuban ores, on the amount which the two steel companies are arranging to move. By countries the tonnage for the past seven years and for 1910 are given in the accompanying table.

IMPORTS OF IRON ORE INTO THE UNITED STATES SINCE 1903, WITH 1910 ESTIMATE.

	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
	(Tonnage statistics compiled by Dept. of Commerce and Labor.)						(Estimated tonnages.)	
Cuba	613,585	364,630	539,935	639,362	657,133	579,668	800,000	1,500,000
Spain	94,720	36,810	191,861	171,870	296,318	126,074	400,000	700,000
Newfoundland	86,730	5,400	5,600	125,395	89,685	48,285	210,000	300,000
Sweden	.....	.....	.....	.....	.....	.....	200,000	310,000
Russia	.....	.....	.....	.....	54,995	5,750	100,000	.....
Greece	.....	2,500	.....	48,630	23,800	4,850	30,000	50,000
Africa	7,830	.....	.....	.....	65,940	.....	40,000	100,000
Miscellaneous	177,575	78,273	108,255	75,133	41,197	12,271	30,000	100,000
	980,440	487,613	845,651	1,060,390	1,229,168	776,898	1,810,000	3,060,000

"An interesting fact demonstrated by this is that the increase in importations

is not due entirely to more extensive operations in Cuba. During the six years 1903-8, the average movement of Cuban ore was 565,725 tons, out of a total average import movement of 896,-860 tons. For the year just ended, the Cuban shipments were practically equal to the total average importations over these six previous years, but in point of percentage, the showing was not so favorable, as Cuba furnished only about 45 per cent of the total movement in 1909, as compared with an average of almost 63 per cent over this six-year period.

"Another significant feature is that over a considerable term of years ore imports have maintained a very uniform proportion to Lake ore shipments, varying but little from 3 per cent. During 1909, however, this figure suddenly jumped to 5 per cent and, from the most careful estimates of the 1910 movement, will run about 6.8 per cent. It is a remarkable commentary on the magnitude of the American iron industry that changes affecting the ore supplies of an entire producing district can take place without causing any disturbance in the trade and almost without exciting attention or comment."

THE TESTING OF EXPLOSIVES FOR RAILWAY TRANSPORTATION.

A SUMMARY OF THE NEW RULES EMBODIED IN THE GERMAN RAILWAY REGULATIONS.

W. Will and F. Lenze—Zeitschrift für das gesamte Schiess- und Sprengstoffwesen.

AFTER a long series of investigations, the German Commission appointed to formulate a code of rules to govern the acceptance of explosives for railway transportation has presented a provisional report which has been incorporated in the German Railway Traffic Regulations. Dr. W. Will and Dr. F. Lenze, who were responsible for most of the experimental work on which the specifications composing the report are based, have communicated to the *Zeitschrift für das gesamte Schiess- und Sprengstoffwesen* for August 15, 1909, a brief review of the findings of the Commission, which is translated in the *Journal of the Franklin Institute* for January.

Explosives are classified under three fundamental groups, high explosives, powders, and other substances capable of explosion. The high explosives include ammonium nitrate explosives, organic nitro-compounds, nitrated chlorhydrin, nitro-cellulose, chlorate and perchlorate explosives, black powder and similar explosives, and dynamite and similar explosives. The powders include smokeless colloided nitro-cellulose powders with or without nitroglycerine, and black powder.

The investigations of the Commission have shown that certain explosives are safe to handle in unlimited quantities, others can be carried only in packages not exceeding 200 kilograms (440 pounds), still others can be carried only in special car loads. Under the first group are included the so-called ammonium nitrate explosives, the less dangerous nitro-compounds, damp nitrocellulose and certain explosives similar to black powder. The second group include the more insensitive chlorate and perchlorate explosives, wet organic nitro-compounds which are more dangerous than picric acid, and nitrated chlorhydrin. Special car shipments are necessary in the case of dynamite, the more dangerous black powders, gun cotton and collodion cotton, and chlorate and perchlorate explosives.

"Powders may be forwarded in packages in unlimited quantities either as in the first group, including smokeless nitro-cellulose powders (also those containing nitroglycerine) which are well colloided and have certain definite conditions of stability, or as in the second group only in carloads, which include those nitro-cellulose powders which do not attain these conditions of stability, black powder for use as a propellant and similar powders. If certain regulations as to packing are followed, these shooting powders of the second group can be forwarded in packages in quantities up to 200 kilograms (440 pounds)."

The admission of an explosive to railway transportation under any one of these groups is governed by the results of tests of its safety in comparison with that of well known and comparable explosives tested simultaneously, which serve as standards. The tests determine comparative, not absolute, values. The researches of the Commission have shown that the properties most seriously influencing the safety of explosives in transportation are stability in storage, sensitiveness to mechanical influences such as blows and friction, and inflammability and liability to explosion in fire or from the influence of high temperature generally. Of these the last appears to be the most important. Manufacturers may be relied on to furnish explosives of sufficient stability, and the risk of explosion by blows and friction is minimized by the enforcement of the rules for safe packing incorporated in the Railway Traffic Regulations. Tests to determine these three properties, however, are made in all cases. In addition a high explosive submitted for admission to transportation is subjected to a quantitative analysis and to tests to determine its reaction with litmus, its tendency to form salts, and other properties which may require investigation on account of the special nature of the explosive. For example, the composite ammonium nitrate explosives are tested for safety of intermixture by the shaking test; the ammonium nitrate explosives containing nitroglycerine are tested for the exudation of nitroglycerine on the addition of water; the simple nitro-compounds for their tendency to form salts; the nitro-celluloses for their content of water and alcohol, for admixtures and for stability under special conditions; the chlorate explosives for their safety of intermixture and their stability in alternate damp and dry storage; and the dynamites for their exudation of nitroglycerine by sweating in heat. For powders there are specified an investigation of the ingredients, and tests to determine their chemical stability and purity.

"The testing of explosives for storage stability consists of long continued storage of 10 grams in loosely closed bottles at about 75 degrees C. in thermostats or, better, in an oven heated by carbon tetrachloride. It is prescribed that the explosive shall be stored 48 hours without showing visible change, which may be recognized generally by the appearance of yellow fumes (nitrogen oxides), by a peculiar odor or color, by large loss of weight, and so on. Actually, all the hitherto admitted explosives withstand this test for more than eight days. The method of storage at 75 degrees C. is especially adapted for the determination of stability, since the test carried out at a comparatively low temperature and extending over a long period of time more nearly simulates practical conditions than the so-called heat tests which are carried out at a considerably higher temperature (over 100 degrees C.) and are used for testing nitro-cellulose and nitro-cellulose powders for stability."

Sensitiveness to percussion is tested by means of the drop-hammer apparatus. In testing for liability to explosion, the object is to obtain data upon the tendency of explosives to detonate in case they should catch fire during transportation in large quantities, and also to determine whether a mass detonation is to be feared in such a fire. Four different tests are applied to each high explosive. Inflammability is tested by the action of the flash of a Bickford fuse on 3 grams of the explosive. The phenomena of decomposition by slow heating are determined by heating small samples of from 0.1 to 0.5 gram to explosion or complete decomposition, and the phenomena of combustion and eventual explosion by instantaneous overheating, by throwing 5 grams on a red-hot iron plate. The effect of a fierce fire on a confined explosive is determined by calcining in a wood fire from 500 to 1,000 grams, according to the density of the explosive, in sheet iron cases. Experience has shown that the combined data obtained by these methods lead to a safe conclusion as to the liability of an explosive to explosion under the influence of high temperature. The liability to explosion of powders is tested by the behavior of a charge of 0.54 gram in a Trauzl lead block when ignited by a fulminating cap.

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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CIVIL ENGINEERING.

BRIDGES.

Culverts.

Experience with Pipe Culverts of Corrugated Iron. On the uses and service, and types of such culverts. Ills. 1500 w. Eng News—Jan. 20, 1910. No. 10968.

The Kilton Ferro-Concrete Culvert. Illustrated description of a reinforced-concrete culvert built on the North-Eastern Ry. line, England. 500 w. Engng—Dec. 31, 1909. No. 10752 A.

Design.

Calculation of Stresses in Suspension Bridges. Appendices to the report of Ralph Modjeski on the Manhattan bridge. 900 w. Eng Rec—Jan 8, 1910. No. 10694.

A New Moment Table. C. R. Young. Gives a table for shortening calculations for shear and moment due to moving train loads, with explanation. 1000 w. Can Engr—Jan. 7, 1910. No. 10720.

End-Launching.

Launching the Reventazon Bridge, Costa Rica. Illustrated account of a bridge erected on shore and launched. 1800 w. Eng Rec—Jan. 15, 1910. No. 10805.

We supply copies of these articles. See page 970.

Floors.

A Heavy Floor for a Double-Track Bridge. Illustrates and describes the floor system of a bridge in Jersey City, N. J., which carries the D., L. & W., tracks over the Erie R. R. tracks. 900 w. Eng Rec—Jan. 15, 1910. No. 10807.

Piers.

The Substructure of the Passyunk Bridge. Henry H. Quimby. Illustrated description of the construction of piers and abutments for a 12-span steel superstructure, with a double leaf trunnion bascule channel span. The west abutment and 9 piers are of rubble concrete on wooden pile foundations, the other spans are two of rubble concrete carried to bed rock, and one of shallow concrete founded in gravel. Discussion, 7500 w. Pro Engrs' Club of Phila. No. 1076—Oct., 1909. No. 11162 D.

The Construction of the Substructure of the McKinley Bridge Across the Mississippi River at St. Louis, Mo. F. E. Washburn. An illustrated article describing the river conditions, the locating of the piers, caissons, their launching and placing, pier foundations, etc. 11000 w. Eng News—Jan. 6, 1910. No. 10621.

Reconstruction.

Strengthening the Benha Bridge (La Renforcement du Pont de Benha). A. Husson. An account of the reconstruction of this five-span steel-truss railway bridge over the Nile. Ills. 27000 w. Ann d Ponts et Chaussées—1909-VI. No. 11079 E + F.

Widening the St. Florent Viaduct by Means of Reinforced-Concrete Corbels (Note sur l'Exécution des Travaux d'Elargissement du Viaduc de St. Florent, au Moyen d'Encorbellements en Ciment armé). M. Verdeaux. Describes the work of widening this bridge to accommodate a third track. Ills. 3000 w. Rev Gen d Chemins de Fer—Dec., 1909. No. 11014 G.

Reinforced Concrete.

The Mushroom System as Applied to Bridges. C. A. P. Turner. Illustrates and describes pleasing designs executed in this class of concrete-steel work. 1000 w. Cement Age—Jan., 1910. No. 11195.

Long Span Reinforced-Concrete Girder Bridges. F. W. Scheidenhelm. Illustrated description of bridges on an electric interurban line in western Pennsylvania, crossing Dunlap's Creek, near Brownsville. A series of concrete girders on high, slender concrete piers. Reports tests. 8000 w. Eng News—Jan. 27, 1910. No. 11280.

Reinforced Concrete Arch Bridge, Bexar County, Texas. Information regarding the bridge on the Pleasanton road, over the Medina River. Ills. 1500 w. Engng-Con—Jan. 26, 1910. No. 11290.

The Construction of the Rocky River Bridge. Illustrates and describes a reinforced concrete highway bridge under construction near Cleveland, Ohio, which has a central span of 280 ft. 5500 w. Eng Rec—Jan. 1, 1910. No. 10516.

See also Reconstruction, Steel, and Viaducts, under BRIDGES.

Steel.

Road Bridge Over the Klang River, Federated Malay States. Illustrated detailed account of the construction of a four span bridge over a tidal river. Plate. 2200 w. Engng—Jan. 7, 1910. No. 10913 A.

The Clinton Bridge of the Chicago & North Western. Brief account of earlier bridges at this site, crossing the Mississippi, and illustrated description of the new double-track bridge having a total length of 4200 ft. 3500 w. Ry Age Gaz—Jan. 14, 1910. No. 10880.

Steel and Reinforced Concrete Bridge Superstructures for the Bay Ridge Improvement of the Long Island Railroad. James B. French. Illustrated detailed description of street bridges carrying street traffic over railroad tracks, and railroad bridges, carrying tracks over streets. 5000 w. Cornell Civ Engr—Jan., 1910. No. 11153 C.

See also End-Launching and Reconstruction under BRIDGES.

Swing Bridges.

Making a Second Passage Through the Vlake Bridge over the Zuid-Beveland Canal (Het maken van een tweede doorvaartopening in de spoorwegbrug over het Kanaal door Zuid-Beveland te Vlake). Ch. Driessen. Describes the work of altering foundations, deepening the channel, etc. Ills. 7000 w. De Ingenieur—Nov. 6, 1909. No. 11229 D.

Transporter.

A Transporter Bridge over the Oste at Osten (Schwebefähre über die Oste bei Osten). Detailed description of the steel bridge and traveller. Ills. Serial. 1st part. 2000 w. Deutsche Bau—Dec. 4, 1909. No. 11070 B.

Viaducts.

The Fades Viaduct. Illustrated description of this steel viaduct in France, in the Paris-Orleans Ry., and its construction. 2500 w. Engng—Dec. 31, 1909. No. 10750 A.

The Erection of the Brandywine Viaduct. Brief illustrated description of the methods used at Cleveland, Ohio, in erecting a double-track steel-plate girder structure over Brandywine Creek. 1000 w. Eng Rec—Jan. 22, 1910. No. 10973.

The Mulberry St. Reinforced-Concrete Viaduct, Harrisburg, Pa. Illustrated description of one of the longest reinforced-concrete bridges in the world. 3500 w. Eng News—Jan. 13, 1910. No. 10815.

We supply copies of these articles. See page 970.

The Mulberry Street Viaduct, Harrisburg, Pa. John E. Allen and Benjamin G. Love. A reinforced-concrete highway structure of the rib arch type is illustrated and described, and the methods of construction. Discussion. 7500 w. Pro Engrs Club of Phila. No. 1078—Oct., 1909. No. 11164 D.

CONSTRUCTION.

Accounting.

See same title, under INDUSTRIAL ECONOMY.

Boring.

A Special Hand Auger for Test Boring and Method of Using it in Prospecting for Coal. Illustrated description of a tool developed by Baird Halberstadt, the conditions under which it was worked out, and the methods of using it. 1600 w. Engng-Con—Jan. 19, 1910. No. 10943.

Notes on Ocean Borings at New South Wales. C. W. King. Read before the N. Engng. Inst. of N. S. W. Considers the difficulties met with when boring in the open seaway. Ills. 2000 w. Aust Min Stand—Nov. 24, 1909. No. 10627 B.

Inclined Diamond Drill Borings Under the Hudson River. A description of a method, in connection with the work for the New York City water supply, to locate the tunnel grade under the river. 3000 w. Eng Rec—Jan. 15, 1910. No. 10802.

Improvements in Boring Methods (Les Perfectionnements apportés aux Méthodes de Sondage). M. Frochot. A review of boring methods and particularly recent developments. Ills. Serial. 1st part. 5500 w. Tech Mod—Dec., 1909. No. 11018 D.

Caissons.

Modern Steel Caissons. J. F. Springer. An account of their development and application in subaquious work. Ills. 9500 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10689 D.

Pneumatic Caisson Work on the McKinley Bridge. C. E. Chase. Illustrated description of methods used in constructing the substructure of this bridge across the Mississippi River at St. Louis. 3000 w. Cornell Civ Engr—Jan., 1910. No. 11154 C.

Columns.

The Rankine-Gordon and Euler's Formulae for Columns. W. E. Lilly. Aims to show wherein the Eulerian analysis fails and considers the derivation of the Rankine-Gordon formula from the analysis when it is extended to include the case of eccentrically-loaded columns. 2000 w. Engng—Jan. 14, 1910. No. 11122 A.

Concrete.

Reducing the Cost of Concrete Building Work One-Tenth by Raising Labor Efficiency by Rivalry. Walter B. Snow. An account of work for the Winchester Repeating Arms Co., at New Haven, Conn. 1200 w. Engng-Con—Jan. 26, 1910. No. 11291.

Pressure of Concrete on Forms. Information in regard to experiments made by Maj. Francis R. Shunk to determine the pressure at various temperatures and rates of filling. 1500 w. Eng Rec—Jan. 15, 1910. No. 10804.

Some Applications of Concrete and Cement to a Central Station System. H. N. Muller. Illustrates and describes novel applications of this material to various construction and repair work in a large central station system. 3000 w. Elec Jour—Jan., 1910. No. 11158.

See also Sewers, under MUNICIPAL; and Elevated Railways, under STREET AND ELECTRIC RAILWAYS.

Conduits.

See same title, under ELECTRICAL ENGINEERING, TRANSMISSION.

Contractor's Plants.

Plant for the Construction of the Concrete Locks in the Panama Canal at Pedro Miguel and Miraflores (Die Bauanlagen zur Herstellung des Betonmauerwerkes für die Schiffschleusen des Panama-Kanales in Pedro Miguel und Miraflores). Walter Rowland. Detailed description. 5000 w. Zeitschr d Ver Deutscher Ing—Dec. 4, 1909. No. 11216 D.

Doors.

A Special Rolling Door for a Crane Runway Opening. A specially designed rolling door for closing a large opening in the main shop of the Heine Safety Boiler Co., is illustrated and described. 700 w. Eng Rec—Jan. 22, 1910. No. 10971.

Earthquake.

The Statics of Construction to Withstand Earthquakes (La Statica delle Costruzioni antisismiche). A. Danusso. Mathematical. 5000 w. Monit Tech—Nov. 30, 1909. No. 11038 D.

See also Building Vibrations, under MISSCELLANY.

Explosives.

A New Explosives Ordinance for the City of Chicago. Gives an ordinance regulating the sale, storage and use of explosives. 4000 w. Eng News—Jan. 13, 1910. No. 10814.

Factories.

Approximate Cost of Mill Buildings. Charles T. Main. A paper read before the New England Cotton Mfrs. Assn. in April, 1904, revised to conform with prices prevailing about Jan., 1910. 1500 w. Eng News—Jan. 27, 1910. No. 11284.

The Blake & Johnson Model Factory. Brief illustrated description of new buildings at Waterbury, Conn. 1500 w. Ir Age—Jan. 6, 1910. No. 10609.

We supply copies of these articles. See page 970.

Floors.

Composite Hollow Tile and Reinforced Concrete Floor Slabs. George S. Drew, Jr. Illustrates and describes this system of construction, explaining the advantages. 2000 w. Br Build—Dec., 1909. No. 10512 D.

A Unique Type of Reinforced Concrete Construction. Theodore S. Condron. Brief illustrated descriptions of seven types of reinforced concrete floor construction, especially explaining the advantages of the paneled slabs without girders or beams. General discussion. 10000 w. Jour W Soc of Engrs—Dec., 1909. No. 11185 D.

Foundations.

A Composite Sand and Rock Foundation for a Tall Building. Plans and description of the unusual foundations for a 25-story municipal building of New York City, describing the conditions which led to the decision to found part of the building on sand. 3000 w. Eng News—Jan. 6, 1910. No. 10623.

Inspection.

Millions Saved by Inspection. An illustrated account of the work of the Division of Inspection of the City of New York. 4500 w. Munic Jour & Engr—Jan. 12, 1910. No. 10721.

Pile Driving.

A New Design of Steam Pile Driver: Comparisons of Several Types of Drivers. A. A. Goubert. Illustrated description of a design of the author. 1800 w. Eng News—Jan. 20, 1910. No. 10967.

Piling.

The Use of Concrete Piles. William F. Hall. Illustrates and describes forms of concrete piles, and their uses, reviewing the advantages of this application of reinforced concrete. 4500 w. Jour Fr Inst—Jan., 1910. No. 11198 D.

Regulations.

An Explanation of the Swiss Regulations for Reinforced-Concrete Construction (Schiarimenti alle norme Svizzere per le Costruzioni in Cemento armato). Ills. 4000 w. Il Cemento—Nov. 30, 1909. No. 11042 D.

Reinforced Concrete.

Industrial Applications of Reinforced Concrete. M. M. Sloan. His second article reviews details of application to foundations, floors and roofs. Ills. 2000 w. Engineering Magazine—Feb., 1910. No. 11237 B.

Ferro-Concrete Construction. Harry W. Taylor. Read before the Assn. of Water Engrs. Considers the factor of safety, design of centering, steelwork, concrete, etc. 3000 w. Surveyor—Dec. 31, 1909. No. 10773 A.

Steel and Concrete. J. F. Springer. Considers their co-ordination in reinforced concrete construction, the application, etc. Ills. 5500 w. Ir Age—Jan. 6, 1910. No. 10618.

Short Methods of Calculation for Checking Reinforced Concrete Work. E. Fiander Etchells. Read before the Inst. of Munic. Engrs. Shows how the formulae are applied in checking an existing design. 2000 w. Archt, Lond—Dec. 24, 1909. Serial. 1st part. No. 10625 A.

The Economy of Plain and Reinforced Concrete Columns. Charles W. Hall. Aims to show that under the conditions imposed by building laws, a reinforced column will in most cases be cheaper. 2000 w. Eng Rec—Jan. 8, 1910. No. 10692.

Stresses in Reinforced Concrete Beams. Discussion of paper by Prof. Gaetano Lanza and Lawrence F. Smith. 11300 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11247 F.

Continuity in Reinforced-Concrete Beams. Letters from R. E. Spaulding, Sanford E. Thompson and R. E. W. Hagerty, discussing this subject. 5000 w. Eng News—Jan. 13, 1910. No. 10818.

The Grand Stand at the Minnesota State Fair Grounds. Illustrated description of a combined exposition building and grand stand built in 80 days. 3000 w. Eng Rec—Jan. 15, 1910. No. 10801.

Reinforced Concrete on the Vandalia Railroad, U. S. A. E. R. Matthews. Illustrates and describes typical structures built of this material. 1800 w. Engng—Jan. 14, 1910. No. 11123 A.

A Boathouse on the Imperial Wharf at Dantzig (Bootsmagazin auf der Kaiserlichen Werft zu Danzig). Herr Röhlke. Describes a large concrete structure for the storage of pleasure boats. Ills. Serial. 1st part. 3500 w. Beton u Eisen—Dec. 16, 1909. No. 11094 F.

See Culverts, under BRIDGES; Retaining Walls, under CONSTRUCTION; Dams, and Tanks, under WATER SUPPLY; and Slide Rules, under MICELLANY.

Retaining Walls.

Some Retaining Wall Construction in Connection with the Chicago & Northwestern Ry. Track Elevation. Work in Chicago. Illustrated description of heavy concrete construction. 1000 w. Engng-Con—Dec. 29, 1909. No. 10547.

The Design of T-Shaped Concrete Retaining Walls. Considering Earth Pressure and the Friction of the Foundation Slab (Die Form der Winkelstützmauern aus Eisenbeton mit Rücksicht auf Bodendruck and Reibung in der Fundamentfuge). Albert Klein. Mathematical. Ills. 3500 w. Beton u Eisen—Dec. 16, 1909. No. 11095 F.

Roofs.

See Reinforced Concrete, under MATERIALS OF CONSTRUCTION.

We supply copies of these articles. See page 970.

Specifications.

Specifications for Office Buildings. Frederick W. Winterburn. Suggestions helpful in writing a good specification. 2500 w. Br Build—Dec., 1909. No. 10513 D.

Stacks.

Factory Chimneys. Explains rules for calculating the safe wind pressure and the maximum compressive stress, illustrating by example. 2500 w. Mech Wld —Jan. 14, 1910. No. 11114 A.

Tapering Concrete Chimneys. Illustrates and describes two examples of tapering stacks built at low cost. 1800 w. Eng News—Jan. 13, 1910. No. 10812.

Reinforced-Concrete Chimneys (Cheminées en Béton armé). E. Cornez. Discusses the applicability of reinforced concrete to chimney construction and illustrates several structures on the Monnoyer system. 2000 w. All Indus—Dec., 1909. No. 11023 D.

Design of a Reinforced-Concrete Chimney (Calcul d'une Cheminée en Béton armé). A. Rosler. Mathematical demonstration of the method of calculation. Ills. 3000 w. All Indus—Dec., 1909. No. 11024 D.

The Stability of Masonry Stacks with Reservoir (Stabilité des Cheminées en Maçonnerie, avec Réservoir). E. Barbieux. Mathematical and theoretical. Ills. 2000 w. All Indus—Dec., 1909. No. 11025 D.

Steel.

The Hotel Martinique Extensions, New York. Illustrates and describes interesting structural features of a 16-story extension of irregular plan. 1000 w. Eng Rec—Jan. 1, 1910. No. 10521.

Tunnels.

Progress on the Rondout Pressure Tunnel. John P. Hogan. An illustrated account of the work and the excellent progress made. 1700 w. Eng Rec—Jan. 1, 1909. No. 10523.

Construction of Line No. 7 of the Metropolitan Railway of Paris (Méthode de Construction du Chemin de Fer Métropolitan Ligne No. 7). A. Pichot. An illustrated description of some of the difficulties overcome. Plate. 2000 w. Tech Mod—Dec., 1909. No. 11020 D.

MATERIALS OF CONSTRUCTION.

Cement.

The Behavior of Hydraulic Cements in Sea Water (Das Verhalten hydraulischer Bindemittel im Seewasser). H. Burchartz. Reports results of tests. Ills. 5000 w. Beton u Eisen—Dec. 16, 1909. No. 11098 F.

Concrete.

Possibilities of the Uses of Mineral Oils Mixed with Concrete. Albert Moyer, Reports tests made of the effect of oil on concrete. 2500 w. Cement—Jan., 1910. No. 11197 C.

Uses of Mineral Oils Mixed with Concrete. Albert Moyer. A report of investigations, made, and the applications where such a mixture would prove desirable. 2500 w. Mfrs' Rec—Jan. 20, 1910. No. 10940.

Reducing Contraction and Absorption of Concrete by Mixing it with Mineral Oil. Albert Moyer. Reports tests made by the author and by others and the results. 1800 w. Engng-Con—Jan. 12, 1910. No. 10821.

Possible Use of Mineral Oils Mixed with Concrete. Albert Moyer. A report of experimental investigations and remarks on the uses and advantages. 2500 w. Eng Rec—Jan. 1, 1910. No. 10518.

Economical Selection and Proportion of Aggregates for Portland Cement Concrete. Albert Moyer. Aims to give a practical method which will enable any concrete constructor to make economical use of the best aggregates, so proportioning them as to give the maximum strength and density with a minimum amount of cement. 6000 w. Engng-Con —Jan. 19, 1910. No. 10941.

Mortars.

Comparative Strength Tests of Cement Mortar (Vergleichende Festigkeitsversuche an Korpern aus Zementmörtel). M. Grübler. Reports and discusses the results. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Dec. 25, 1909. No. 11222 D.

Paints.

Paint, and the Painting of Steel. Gaston Daspierres. On the chemical and physical properties of paints and the proper application of protective coatings. 2500 w. Pub Works—April-June, 1909. No. 10892 D.

A Study of Rust: Preventing Paints for Metal Structures. Emil Camerman. Read before the Int. Assn. for Test. Met. Considers the difficulties rust-preventing paints should meet, and the conditions the paints should fulfil. 1500 w. Mech Engr —Dec. 31, 1909. No. 10775 A.

Reinforced Concrete.

Some Notes on Flexure of Reinforced Concrete. S. H. Ingberg. A mathematical investigation of the stress strain. 1500 w. Minn Engr—Jan., 1910. No. 11157 C.

Test Loading of Reinforced-Concrete Roof Slab with Crossed-Rod Reinforcement (Belastungsversuche mit gekreuztbewehrten Eisenbetondecken). Describes the slabs and the tests, and gives results. Ills. 2000 w. Beton u Eisen—Dec. 16, 1909. No. 11097 F.

Comparative Tests of Concrete Beams Reinforced with Round Rods and Bars of the Johnson Type (Prove comparative su Travi in Beton armate con Tondini o con Quadretti Tipo Jonson). Camillo Guidi. Tabulates and discusses the results. Ills. 4000 w. Il Cemento—Dec. 15, 1909. No. 11043 D.

We supply copies of these articles. See page 970.

Steel Corrosion.

Rapid Deterioration of Steel Work from the Corrosive Action of Locomotive Gas. McCallie Avenue Bridge, Chattanooga, Tennessee. Information from a report of Robert Hooke on the rapid deterioration of steelwork under the corrosive action of locomotive gases and smoke. 1200 w. Eng News—Jan. 20, 1910. No. 10962.

MEASUREMENT.

Cement Testing.

The Determination of the Total Basicity of Cement (La Determinazione della Basicità totale del Cemento). A discussion of the chemistry of cement testing. Serial. 1st part. 2200 w. Il Cemento—Dec. 15, 1909. No. 11044 D.

Hydrographic Surveying.

Hydrographic Explorations (Exporation hydrographique des Mers). A report of the discussion at the Eleventh International Congress at St. Petersburg, 1908. 3800 w. Ann d Ponts et Chaussées —1909-VI. No. 11083 E + F.

Surveying.

Effect of the Inclination of the Stadia Rod Upon Stadia Distances. Boris Levitt. Aims to trace the effect of the inclination of the rod upon the reduced horizontal and vertical distances and upon the vertical angles. Mathematical. 2500 w. Sch of Mines Qr—Nov., 1909. No. 11166 D.

Work of a United States Deputy Surveyor. Louis Ross. An explanation of the methods, problems, requirements, etc., with the actual field processes and the work generally. 8000 w. Harvard Engng Jour—Jan., 1910. No. 11148 D.

MUNICIPAL.

Drainage.

The Care of Surface Water at Street Intersections. S. D. Newton. Read before the Am. Soc. of Munic. Imp. Remarks on methods used in Knoxville, Tenn. 2500 w. Munic Engng—Jan., 1910. No. 11192 C.

The Main Drainage of London. Maurice Fitzmaurice. Reviews the history of London drainage, describing recent work, and work under construction or proposed. 8800 w. Pub Works—April-June, 1909. No. 10891 D.

Gravel Washing.

Gravel Washing Plants. General description with details of the standard plant arrangement developed by the J. C. Buckbee Co. of Chicago. Ills. 3000 w. Eng Rec—Jan. 15, 1910. No. 10810.

Pavements.

Economics of Street Pavements. From a report by Samuel Whinery to the Finance Commission of Boston. Discusses factors to be considered in determining the comparative economy of the different pavements. 1800 w. Engng Con —Jan. 12, 1910. No. 10823.

Concrete Paving at Memphis. J. H. Weatherford. An illustrated report of methods, and of the wearing qualities of concrete pavement. 1500 w. Munic Jour & Engr—Jan. 5. 1910. No. 10653.

Refuse Disposal.

Municipal Waste. William Calder. Read before the Australian Health Soc. An account of methods and results at Prahran, Victoria, in its collection and disposal. 4500 w. Surveyor—Jan. 7, 1910. Serial. 1st part. No. 10905 A.

Roads.

The Motor Car and the Road. Logan Waller Page. An illustrated discussion of the destructive effect of high speed and the remedy. 2500 w. Sci Am—Jan. 15, 1910. No. 10796.

Road Construction and Maintenance in Cumberland County, England. George Joseph Bell. Brief account of the methods used. 1000 w. Eng News—Jan. 27, 1910. No. 11289.

Some Methods of Securing Better Roads in the South. E. E. Miller. A discussion of conditions in the south, the need of educating the people in regard to the value of good roads, and the best ways of securing them. 3500 w. Mfrs' Rec—Jan. 20, 1910. No. 10939.

Rural Districts.

A Record of Twenty-five Years' Experience in a Rural District. William Whitehouse. Considers some of the difficulties which had to be overcome in meeting the demand for water, drainage requirements, roads, etc. Ills. 4500 w. Surveyor—Jan. 7, 1910. Serial. 1st part. No. 10904 A.

Sanitation.

The Disposal of Dairy Wastes. Notes from a bulletin of the Ohio State Board of Health, prepared by A. Elliott Kimberly, giving an account of experimental work. 2500 w. Eng Rec—Jan. 8, 1910. No. 10695.

Sewage Disposal.

Sludge Disposal. W. C. Easdale. Read before the Inst. of Munic. Engrs. Paper and discussion of methods suggested and tried. 4400 w. Surveyor—Dec. 24, 1909. No. 10629 A.

Sewage Disposal Works at the Danville State Hospital. Illustrated description of a system of separate sewers and a sewer disposal works recently installed in Pennsylvania. 1500 w. Eng Rec—Jan. 15, 1910. No. 10806.

Disposal of Manufactural Wastes and Sewage at Gloversville, N. Y. Full abstract of report by Harrison P. Eddy and Morrell Vrooman on unusual experimental investigations of sewage treatment. 4500 w. Eng Rec—Jan. 22, 1910. Serial. 1st part. No. 10976.

We supply copies of these articles. See page 970.

Ocean Grove Sewage Disposal Plant. Clyde Potts. Illustrated description of the Embury Avenue tank and the method of disposing of sewage so as not to contaminate the beach. 1500 w. Eng Rec—Jan. 8, 1910. No. 10697.

Sewers.

A Comprehensive Sewer System for Kansas City, Mo. Jean Bart Balcomb. Map, sections and description of the plans, design, organization and construction of work in progress. 1800 w. Eng News—Jan. 27, 1910. No. 11282.

Methods and Cost of Constructing Concrete Sewers at Richmond, Ind. Fred. R. Charles. Illustrated account of methods used and related subjects. 2500 w. Engng-Con—Dec. 29, 1909. No. 10550.

Stone Crushing.

The Costs of Producing Crushed Stone in Boston, Mass., by City Operated Crushing Plants. Data from the report of Samuel Whinery on the cost of crushing stone at these crushers, with editorial. 8000 w. Engng-Con—Dec. 29, 1909. No. 10548.

Street Cleaning.

Town Scavenging and Refuse Disposal. Hugh S. Watson. Describes English methods of cleaning the various classes of pavements. 1500 w. Munic Engng—Jan., 1910. No. 11190 C.

WATER SUPPLY.

Aqueducts.

Cut and Cover Construction on the Catskill Aqueduct. Illustrated detailed description of work near New York City. 4000 w. Eng Rec—Jan. 8, 1910. No. 10690.

Artesian.

The Deep Well System of Water Supply for South Bend, Ind. Alonzo T. Hammond. Abstract of paper read before the Indiana Engng. Soc. Describes this system of artesian well supply, discussing the gradual decrease of flow, the conditions and needs. 1500 w. Eng News—Jan. 27, 1910. No. 11283.

Ashokan.

Progress on the Ashokan Reservoir. A review of work during the past year. Ills. 1500 w. Eng Rec—Jan. 22, 1910. No. 10972.

The World's Biggest Water Project. Illustrated account of New York's new water supply, containing 90 miles of aqueducts and tunnels. 4500 w. Munic Jour & Engr—Jan. 19, 1910. No. 10933.

Cheyenne, Wyo.

The Water Supply System of Cheyenne, Wyoming. Illustrates and describes improvements undertaken to increase the water supply, and proposed developments for future needs. 4500 w. Eng Rec—Jan. 22. 1910. No. 10977.

Dams.

The Failure of a Small Concrete Dam. Smith O. Steere. Illustrated description of a dam near Dansville, N. Y., and an account of its failure. 1700 w. Eng Rec—Jan. 1, 1909. No. 10522.

The Failure of a Concrete Dam at Dansville N. Y. An illustrated account of the failure on Dec. 5 of the dam across Canaseraga Creek. 1200 w. Eng News—Jan. 13, 1910. No. 10819.

Earth and Rock Fill Dam with Concrete Core Wall, Patillas Irrigation Project, Rorto Rico. Drawings and explanation of the main structural features. 1500 w. Engng-Con—Jan. 19, 1910. No. 10942.

A Big Goldfields Dam in New Zealand. P. Galvin. Illustrated description of the construction of the Eweburn dam, in Central Otago, and some of the difficulties met. An earth embankment, with impervious face of specially puddled clay. 1200 w. Aust Min Stand—Dec. 15, 1909. No. 10889 B.

A Multiple Arch Dam. Describes a concrete dam recently built at Hume, Cal. Ills. 1200 w. Eng Rec—Jan. 15, 1910. No. 10803.

The Southern Munich Municipal Water Power Plant (Die Wasserkraftanlage im Süden der Stadt München). J. Bosch. Illustrates and describes the concrete weir construction. Serial. 1st part. 2800 w. Beton u Eisen—Dec. 16, 1909. No. 11093 F.

See also Locks, and River Regulation, under WATERWAYS AND HARBORS.

Ground Waters.

Ground Waters as Sources of Public Water Supplies. William S. Johnson. Deals with conditions in New England, discussing some reasons why ground waters are more satisfactory than surface sources, and their objectionable and troublesome features. General discussion. 13500 w. Jour N Eng W-Wks Assn—Dec., 1909. No. 11180 F.

Irrigation.

Irrigation. E. T. Rowland. Illustrates and describes remains of ancient irrigation works, and also the modern projects of note. 1500 w. Yale Sci M—Jan., 1910. No. 11151 C.

The Practicability and Convenience of a Storage Dam in the Cadillal (Sobre la Practicabilidad y Conveniencia de un Dique de Embalse en el Cadillal). E. Candiani, S. E. Barabino and B. A. Caraffa. Discusses the irrigation problems of Argentina. 3200 w. An d l Soc Cien Argentina—Sept., 1909. No. 11046 N.

New York City.

New York City Water Supply. William W. Brush. Maps and illustrated description of the supplies of Greater New York, using the borough lines as the basis of division. Also discussion. 8800 w. Jour N Eng W-Wrks Assn—Dec., 1909. No. 11179 F.

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Pipe Lines.

Depth of Water Pipe. Gives data from 87 cities collected by New England Water Works Assn., and the effect upon freezing. 3000 w. Munic Jour & Engr—Jan. 5, 1910. No. 10652.

Report of the Committee on the Depth of Laying Water Pipe. Report of a committee appointed to gather statistics relating to the depth at which water pipes are laid and the resulting experience in freezing. Discussion. 6000 w. Jour N Eng W-Wks Assn—Dec., 1909. No. 11181 F.

Purification.

The Water Purification Works at Canon City, Colo. Illustrated detailed description. 2200 w. Eng Rec—Jan. 15, 1910. No. 10809.

Iron Lime Coagulation at St. Louis. Charles Claude Casey. Illustrated description of a nearly automatic coagulant house that has been in successful operation for six months. 3300 w. Munic Jour & Engr—Jan. 5, 1910. No. 10651.

Reservoirs.

Covering of the Distributing Reservoirs at Reading, Pa. Illustrates and describes the relining and covering with a ground arch vaulting of concrete, and constructing on top a public skating rink. 1200 w. Eng Rec—Jan. 22, 1910. No. 10975.

See also Ashokan, under WATER SUPPLY.

Tanks.

A Graphical Method of Determining Stress Distribution in the Walls of Concrete Cylindrical Reservoirs (Graphisches Verfahren für die Ermittlung der Spannungsverteilung in zylindrischen Behälterwänden). Karl Federhofer. Mathematical. Ills. 1000 w. Beton u Eisen—Dec. 16, 1909. No. 11096 F.

Water Works.

The Water Works of Marion, Ind. Elkanah Hulley. Abstract of the history of these works with illustrations. 2000 w. Munic Engng—Jan., 1910. No. 11191 C.

Water-Works Railway.

The St. Louis Water Works Railway. Charles Claude Casey. An account of a railway operated exclusively on the pass system, doing both freight and passenger business. 3000 w. Munic Engng—Jan., 1910. No. 11194 C.

WATERWAYS AND HARBORS.

Canals.

The Proposed Lake Washington Canal, Seattle, Wash: A Great Engineering Project. Archibald O. Powell. Describes the engineering and commercial features of the proposed canal, and explains the causes of the delay in construction. Ills. 4000 w. Eng News—Jan. 6, 1910. No. 10619.

The Proposed Mid-Scotland Canal. Marquess of Graham. A criticism of the scheme. 4500 w. Nineteenth Cent—Jan., 1910. No. 11175 D.

Progress on the Moldau-Elbe Canal in Bohemia in 1908 (Die Tätikeit der Kommission für die Kanalisierung des Moldau- und Elbeflusses in Böhmen im Jahre 1908). Describes the work in progress and the main features of the canal. Ills. 3500 w. Oest Wochenschr f d Oeffent Baudienst—Dec. 18, 1909. No. 11202 D.

Chicago.

The Chicago Harbor. John M. Ewen. Remarks on the importance of water transportation in the development of Chicago both in the past and future, with discussion of the recommendations of the Harbor Commission. Also general discussion. 18000 w. Jour W Soc of Engrs—Dec., 1909. No. 11183 D.

Docks.

Description of the New Harbor, Wet Dock, and Graving Dock at Avonmouth, Bristol, England, Showing the Most Modern Principles of Construction and Equipment of Docks as Adopted in Great Britain. A. D. Swan. Ills. 7000 w. Can Soc of Civ Engrs—Dec. 16, 1909. No. 11143 N.

Dredges.

A Large Elevator Dredge for Work in Boston Harbor. Illustrated description of an unusually large elevator dredge and the method of operation. 800 w. Eng News—Jan. 27, 1910. No. 11285.

Modern Dredging Appliances for Waterways. J. A. Seager. An illustrated description of modern machines used in the development of waterways and harbors. 3500 w. Cassier's Mag—Jan., 1910. No. 11189 B.

Dry Docks.

The Electrical Equipment of Smith's Docks, Middlesbrough. An illustrated account of the electrical equipment of extensive works. 1600 w. Engr, Lond—Jan. 14, 1910. No. 11130 A.

A Large Wooden and Steel Floating Dry-Dock. Illustrated description of a dock for the Erie Basin, Brooklyn, N. Y., of interest on account of its size, construction details, operation, and the rapidity with which vessels can be received and discharged. 2200 w. Eng Rec—Jan. 8, 1910. No. 10696.

See also Docks, under WATERWAYS AND HARBORS.

Great Britain.

The Canal Inquiry. Reviews the fourth report of the Royal Commission on Canals and Waterways. 2500 w. Elec Rev, Lond—Jan. 14, 1910. Serial. 1st part. No. 11107 A.

Harbors.

Construction of Ports on Sandy Beaches (Construction des Ports en Plage de Sable). A report of the discussion at the Eleventh International Navigation

Congress, St. Petersburg, 1908. 6000 w. Ann d Ponts et Chaussées—1909-VI. No. 11081 E + F.

Eleventh International Navigation Congress, St. Petersburg, 1908 (XIe Congrès International de Navigation tenu à Saint Pétersbourg en 1908). A report of the discussion on inland sea-ports, means of access, etc. 10000 w. Ann d Ponts et Chaussées—1909-VI. No. 11080. E + F.

Locks.

Large Angle Valves for the Panama Canal. Illustrated detailed description. 1000 w. Am Mach—Vol. 33. No. 4. No. 11276.

Methods and Cost of Constructing a Concrete Lock and Timber Crib Dam With Appurtenant Structures Employing Day Labor. Gives itimized unit cost of the various classes of work in constructing a dam in Arkansas involving a total expenditure of $288,072. 6500 w. Engng-Con—Jan. 26, 1910. Serial. 1st part. No. 11293.

Miike.

The New Miike Harbor and Its Coal-Loading Equipment (Der neue Miike-Hafen und seine Kohlenladeeinrichtung). H. Nölke. Detailed description of this Japanese harbor. Ills. 3400 w. Zeitschr d Ver Deutscher Ing—Dec. 11, 1909. No. 11218 D.

Mississippi River.

The Reservoir Possibilities of the Sources of the Mississippi and Tributaries of the Upper Mississippi River with Reference to the Improvement of Navigation. Charles W. Durham. Aims to show greatest practicable extent to which the reservoir systems may be carried, and the effect on the improvement of navigation below St. Paul. 5500 w. Eng News—Jan. 20, 1910. No. 10961.

Panama Canal.

See Contractors' Plants, under CONSTRUCTION.

Piers.

Reconstruction of the Tyne North Pier. Abstract of a paper by Ivan Collingwood Barling, read before the Inst. of Civ. Engrs. describing this work. 1200 w. Engng—Jan. 21, 1910. No. 11391 A.

Substructure of Pier 4, Boston Terminal, Boston & Albany R. R. Illustrates and describes work in connection with the improvement on the Boston water front, which is designed to be of the most efficient and durable construction. 2500 w. Eng Rec—Jan. 29, 1910. No. 11317.

River Regulation.

Stream Regimen and Dam Construction in the Eastern Alps (Ueber Flussregime und Talsperrenbau in den Ostalpen). Max Singer. Describes the river-regulation problems in the principal water-power region of Austria. Ills. Serial. 1st part. 5000 w. Zeitschr d Oest Ing u Arch Ver—Dec. 10, 1909. No. 11099 D.

Ship Lifts.

A Ship Lift Operated by a Screw Working in an Inclined Rack (Das Schiffshebewerk mit Schraubenführung auf schiefer Ebene mit Querneigung). Fr. Jebens. Illustrated detailed description. 4500 w. Glasers Ann—Dec. 15, 1909. No. 11087 D.

U. S. Waterways.

Inland Waterways Transportation in the United States. Considers the report of the National Waterways Commission on the decline in inland waterways transportation and in canal transportation. 5800 w. Eng Rec—Feb. 5, 1910. No. 11484.

Water Powers.

New York's Conservation of Water Resources. Discusses the legislative action of the state on the question of developing controlling and regulating the water supply. Ills. 6000 w. Am Rev of Revs—Jan., 1910. No. 11137 C.

Water Powers of the South. Henry A. Pressey. An illustrated article discussing recent industrial development in the South, the undeveloped mountain streams, conditions affecting stream flow, water power control, etc. 5000 w. Am Rev of Revs—Jan., 1910. No. 11136 C.

MISCELLANY.

Building Vibrations.

The Vibration and Oscillation of Buildings (Le Vibrazioni e le Oscillazioni nei Fabbricati). P. Guido Alfani. Gives an account of researches carried out on a high tower and an electric generating station, dicsussing the application of the results to the problems of earthquake construction. Ills. Serial. 1st part. 2000 w. Monit Tech—Dec. 20, 1909. No. 11039 D.

Graphical Charts.

Logarithmic Diagrams Based on Isoplethe Points. H. A. Gehring. Explains the construction of diagrams by this method. 3000 w. Eng Rec—Jan. 15, 1910. No. 10808.

Review of 1909.

Retrospect of the Year 1909. Brief review of what has been achieved in exploration, civil, naval, military and marine engineering, railroading, the sciences, etc. 6500 w. Sci Am—Jan. 1, 1910. No. 10515.

Slide Rules.

A Slide Rule for Reinforced Concrete Slabs. Arthur W. French. Explains this device and its use in calculating concrete structures. 1000 w. Jour Worcester Poly Inst—Jan., 1910. No. 11152 C.

U. S. Reclamation Service.

Secretary Ballinger and the United States Reclamation Service. Editorial on the difficulties met in the administration of the Reclamation Service, reviewing the present situation and the acts of Secretary Ballinger. 4200 w. Eng News—Jan. 13, 1910. No. 10817.

We supply copies of these articles. See page 970.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Radio-Telegraphy.

The Balsillie System of Radio-Telegraphy. Illustrated description of a system which combines the detector and tuner in one piece of apparatus. 1600 w. Elect'n, Lond—Jan. 7, 1910. No. 10902 A.

Peukert's High-Frequency Generator for Wireless Telegraphy on the Quenched Spark Method. L. H. Walter. Reviews the main features of an investigation carried out by Dr. A. Wasmus of a generator of this type. Ills. 3000 w. Elect'n, Lond—Jan. 14, 1910. No. 11110 A.

The Establishment of a Wireless Telegraph Station (Installation d'un Poste de Télégraphic sans Fil). Maurice Guéritat. A detailed description of the steps in installing a wireless station. Ills. 2500 w L'Elecn—Dec. 4, 1909. No. 11027 D.

Radio-Telephony.

The Wireless Telephone. John L. Hogan, Jr. Discusses its present status and probable lines along which future development will proceed. 1500 w. Elec Wld Jan. 13, 1910. No. 10836.

Telecontrol.

New Method of Telecontrol. C. L. Durand. Illustrated description of a system brought out in Germany. 1000 w. Elec Rev, N Y—Jan. 8, 1910. No. 10713.

Telegraphy.

Uses of Electricity in the New White House Offices. Waldon Fawcett. Illustrates the fine telegraphic and telephonic equipment, describing the important uses. 2000 w. Elec Rev, N Y—Jan. 1, 1910. No. 10588.

Telephony.

Economy of Proper Telephone Engineering. Kempster B. Miller. Read before the Int. Ind. Tel. Assn. Considers telephone engineering as related particularly to independent telephony. 3500 w. Elec Rev, N Y—Jan. 1, 1910. No. 10591.

Effect of Phase of Harmonics upon Acoustic Quality. M. G. Lloyd and P. G. Agnew. Describes experiments making use of electrical currents where wave form could be controlled, a telephone receiver being used to transform these into sound waves. 2500 w. Bul Bureau of Stand—Nov., 1909. No. 11171 N.

Telephone Statistics (Welttelephonstatistik—Der Vorsprung Amerikas). Hans v. Hellrigl. A review of the telephone industry of the world, especially commenting on its development in America. 5500 w. Elektrotech u Maschinenbau—Dec. 12, 1909. No. 11211 D.

See also Telegraphy, under COMMUNICATION.

DISTRIBUTION.

Current Rectifiers.

Crystal Rectifiers for Electric Currents and Electric Oscillations. G. W. Price. Abstract from *Phys. Rev.* Considers anatase, brookite and molybdenite. 2500 w Elec'n, Lond—Dec. 24, 1909. No. 10633 A.

Fuses.

The New Diazed System of Fuses and its Origin (Das neue Diazed-Sicherungssystem und seine Entstehung). Paul H. Perls. Illustrated description. 3500 w. Elektrotech u Maschinenbau—Dec. 12, 1909. No. 11210 D.

Relays.

Relays in Distribution Systems. J. W. Hemmelsbach. Considers the principal types of overload and reverse-current relays and their application. 3500 w. Power—Jan. 4, 1910. No. 10608.

Switches.

Recent High-Tension Switch Gear (Aufbau von neueren Hochspannungs-Schaltanlagen). W. Vogel. A review of recent types of apparatus. Ills. Serial. 1st part. 4000 w. Elek Kraft u Bahnen—Dec. 24, 1909. No. 11207 D.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Gas-Engine Alternators in Parallel. Warren H. Miller. Gives observations and conclusions from their practical operation. 3000 w. Elec Wld—Jan. 6, 1910. No. 10841.

Armature Reactions and the Compounding of Alternators (Réaction d'Induit et Compoundage des Alternateurs). MM. Dalémont and Herdt. Presents a new method of compounding alternators. Ills. 9000 w. Bul Soc Int des Elecns—Dec., 1909. No. 11006 F.

A. C. Generators and Transformers with Small Short-Circuit Current (Wechselstrom-generatoren und Transformatoren mit geringem Kurzschlussstrom). F. Niethammer. Describes their construction. Ills. 2500 w. Elek Kraft u Bahnen—Dec. 14, 1909. No. 11205 D.

A. C. Motors.

On the Space Economy of the Single-Phase Series Motor. William S. Franklin and Stanley S. Leyfert. Discusses the question of the maximum single-phase series motor rating that can be placed within a given space. Ills. 3500 w. Pro Am Inst of Elec Engrs—Jan., 1910. No. 11248 F.

Commutators.

Common Commutator Troubles. Cec. Toone. Deals with the causes of selective commutator burning. 2500 w. Elec Rev, Lond—Jan. 7, 1910. No. 10898 A.

We supply copies of these articles. See page 970.

Hunting.

The Hunting of an Electrically-Coupled Series Generator and Motor. W. W. Firth. A report of experimental tests, giving a probable explanation of the cause. 1000 w. Elec'n, Lond—Dec. 31, 1909. No. 10747 A.

Motor-Generators.

Efficiency of Motor-Generators vs. Synchronous Converters. F. M. Farmer. Read before the N. E. L. A., 1909. Considers the two standard types of motor-generator equipments and three of synchronous-converter equipments, giving report of efficiency tests, cost, etc. Diagrams. 6000 w. Elec Age—Dec., 1909. No. 10541.

Speed Regulation.

A Sensitive Speed Regulator for Electric Motors. E. Giebe. Abstract of an article in the *Zeit. für Instrumentenkunde*. Illustrated description of a regulator which automatically maintains the constancy of a direct-current motor to a high degree of accuracy. 1000 w. Elect'n, Lond—Jan. 7, 1910. No. 10900 A.

Synchronous Converters.

See Motor-Generators, under DYNAMOS AND MOTORS.

ELECTRO-CHEMISTRY.

Carbon Disulphide.

New Methods and Apparatus for the Production of Carbon Disulphide in the Electric Furnace (Neue Verfahren und Apparate zur Darstellung von Schwefelkohlenstoff im elektrischen ofen). Edward R. Taylor. Ills. Serial. 1st part. 1400 w. Elektrochem Zeitschr—Dec., 1909. No. 11047 D.

Electric Furnaces.

Current-Densities and Energy Losses in Electrodes. Jakob Forssell. Considers the different factors influencing the energy losses in electric furnace electrodes. 1200 w. Met & Chem Engng—Jan., 1910. No. 10830 C.

Automatic Regulation for Electric Furnaces. L. Kolowrat. Trans. from the *Bul. of the Soc. Française de Physique*. Describes an arrangement for maintaining a constant high temperature over long periods in an electric furnace of the resistance type. 800 w. Elec'n, Lond—Dec. 31, 1909. No. 10746 A.

An Electric Furnace (Four électrique). M. O. Boudouard. Illustrated description of the author's furnace, with results of tests. 1200 w. Bul Soc d'Encour—Dec., 1909. No. 11228 G.

Electrolysis.

Industrial Electrolysis. Prof. B. Lepsius. Trans. from *Umschaz*. Considers the employment of electrolysis in chemical manufacture. 2000 w. Sci Am Sup—Jan. 8, 1910. No. 10672.

Ozone.

Ozone: Its Electrical Production and Use. A. Mabille. Explains the wide field of usefulness. 1600 w. Elec Rev, Lond—Dec. 31, 1909. No. 10781 A.

ELECTRO-PHYSICS.

Magnetic Properties.

The Magnetic and Electrical Properties of the Iron-Nickel Alloys. Charles F. Burgess and James Aston. Deals with an investigation of a series of these alloys in which an effort was made to keep down the impurities to the lowest possible point. 2500 w. Met & Chem Engng—Jan., 1910. No. 10829 C.

Oscillations.

Coupled Circuits in Which the Secondary Has Distributed Inductance and Capacity. Louis Cohen. A mathematical investigation. 1000 w. Bul Bureau of Stand—Nov., 1909. No. 11170 N.

The Effect of Electrical Oscillations on the Conductivity Imparted to Gases by an Incandescent Cathode. Orin Tugman. Report of an investigation to determine the currents which could be sent through the space between the cold conductor and the hot filament when the electrical oscillations were superimposed or direct applied P. D. A. 1000 w. Elec'n, Lond—Jan. 7, 1910. No. 10901 A.

Resistances.

Heavy-Current Resistances of Small Inductance. E. Orlich. Abstract from the *Phys. Tech. Reich*, appearing in the *Zeit. für Inst.* Explains the theory and construction. Ills. 1800 w. Elec'n, Lond—Dec. 24, 1909. No. 10636 A.

Theory.

Five Years of Electrical Theory. E. E. Fournier d'Albe. Reviews the chief contributions to electrical theory which have appeared in the last five years, with special reference to the physics of the ether, of electro-magnetic mass, the principle of relativity and other developments. 4000 w. Elec'n, Lond—Jan. 7, 1910. Serial. 1st part. No. 10903 A.

Zinc Amalgams.

The Electromotive Force of Zinc Amalgams. Prof. Ernst Cohen and W. Tombrock. Abstract of paper in the *Pro. of the Roy. Acad. of Amsterdam*. Gives results of investigations. 500 w. Elect'n, Lond—Jan. 14, 1910. No. 11113 A.

GENERATING STATIONS.

Austria.

A Comparison of Generating-Station Statistics for Austria with other Statistics (Neuere Ergebnisse der Statistik der Elektrizitätswerke in Oesterreich im Vergleiche mit den Ergebnissen anderer Statistiken). L. Rosenbaum. The comparison is with Germany. Ills. 2500 w. Elektrotech u Maschinenbau—Dec. 26, 1909. No. 11217 D.

Boosters.

Continuous-Current Boosters and Bal-

ancers. W. A. Ker. Abstract of a paper read before the Glasgow Sec. of the Inst. of Elec. Engrs. Describes the operation of boosters in a 2-wire system and the principle of a balancer on a 3-wire network, discussing arrangements and related matters. 4200 w. Elect'n, Lond—Jan. 7, 1910. No. 10899 A.

Central Stations.

From Coal Pile to Third Rail. William B. Kouwenhoven. First of a series of illustrated articles describing the power equipment of a large railway system using electricity as the motive power. 2000 w. Ry & Loc Engng—Jan., 1910. Serial. 1st part. No. 10560 C.

Power Stations and Distribution Systems. Louis Bell. Reviews the progress in this field during 1909. 1000 w. Elec Ry Jour—Jan. 1, 1910. No. 10526.

Central Stations for Towns of 1000 or 1200 Inhabitants. Caryl D. Haskins. Condensed reprint from *Gen. Elec. Rev.* Facts and figures relating to the cost of such installations. 2500 w. Elec Rev, N Y—Jan. 8, 1910. Serial. 1st part. No. 10715.

Power Development for the Scranton Shops. Illustrated detailed description of the Hampton power plant of the Delaware, Lackawanna & Western, which furnishes power for the railway shops. 2500 w. Ry Age Gaz—Jan. 7, 1910. No. 10699.

Power House Economics in Baltimore. Horatio A. Foster. An explanation of the problems encountered and their solution. Ills. 2000 w. Elec Rev, N Y—Jan. 8, 1910. Serial. 1st part. No. 10714.

The Newcastle-upon-Tyne Electric Supply Company, Limited. Gives the history of this company, with illustrated description of the Carville power station. 5000 w. Col Guard—Dec. 31, 1909. No. 10769 A.

See also Vacuum, under STEAM ENGINEERING.

Economics.

Financial Equations for Central Stations. L. Crouch. Gives mathematical relationships evolved by M. Jean Mathieu. 600 w. Elec Rev, Lond—Dec. 31, 1909. No. 10780 A.

Polyphrase Motors for Machinery Driving. H. B. Poynder. Read before the Assn. of Engineers-in-Charge. Shows means for profitably utilizing the day load. Ills. 9000 w. Pub Works—April-June, 1909. No. 10890 D.

Motor Loads and Incomes. Alton D. Adams. An analysis of the motor business of 16 central stations. 2000 w. Elec Wld—Jan. 13, 1910. No. 10837.

See also Heating, under POWER APPLICATIONS.

Hydro-Electric.

An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls. C. W. Jordan. Information, up-to-date, of this large and interesting plant, with illustrations. 11000 w. Inst of Mech Engrs—Jan. 7, 1910. No. 11120 N.

McCall Ferry Hydro-Electric Station. H. Prime Kieffer. Illustrated description of this large development in Pennsylvania of interest not only for its magnitude, but for the original methods of construction employed. Plate. 4800 w. Engng—Jan. 7, 1910. No. 10912 A.

Southern Hydro-Electric Power Development. Wade H. Harris. An illustrated review of the remarkable development and some of the reasons that made it possible. 1700 w. Mfrs' Rec—Jan. 6, 1910. (Special No.) No. 10677 C.

Hydroelectric Development of the Minidoka Project. A hydro-electric development having an initial normal capacity of 6000 kw. as a part of an irrigation project in Idaho is described. 5500 w. Eng Rec—Jan. 8, 1910. No. 10693.

Two Hydroelectric Developments on the Peshtigo River. Illustrated description of developments at Johnson's Falls and High Falls in Wisconsin. 2500 w. Eng Rec—Jan. 1, 1909. No. 10519.

Juniata Water & Water-Power Company. Illustrated description of a combination hydroelectric and steam generating station at Warrior Ridge, Pa., with the transmission system. 1600 w. Elec Wld—Jan. 20, 1910. No. 10945.

An Alaskan Hydroelectric Development. M. Adler. Brief illustrated description of the electrical refrigeration plant of the New England Fish Co., at Ketchikan, Alaska. 800 w. Elec Wld—Jan. 13, 1910. No. 10835.

Some Large European Water-Power Plants and Their Operation (Ueber einige grosse europäische Wasserkraftanlagen und ihre Wirtschaftliche Bedeutung). Theodor Koehn. A review of European hydro-electric practice. Ills. Serial. 1st part. 6000 w. Die Turbine—Dec. 20, 1909. No. 11077 D.

The Sonzier Plant of the Société romande d'Electricité (Usine de la Société romande d'Electricité à Sonzier sur Montreux). J. Michaud. Describes an important Swiss plant. Ills. Serial. 1st part. 2000 w. Bul Tech d l Suisse Romande—Dec. 10, 1909. No. 11026 D.

Enlargement of the Schaffhausen Municipal Electric Plant (Die Erweiterungsbauten des Elektrizitätswerks der Stadt Schaffhausen). H. Geiser. Describes the development and the recent enlargement of this important Swiss plant. Ills. Serial. 1st part. 1000 w. Schweiz Bau—Dec. 18, 1909. No. 11072 B.

See also Dams, under CIVIL ENGINEERING, WATER SUPPLY.

Isolated Plants.

Electricity in a Country House. Illus-

trates and describes a 205-h.p. oil-engine generating equipment for the supply of electric light, power and heat. 1400 w. Elec Wld—Jan. 20, 1910. No. 10946.

Rates.

Fixed Charges for Fixed Expenses to Meet the Tungsten Lamp Situation. S. E. Doane. Discusses the cost of service, of electricity, and of the lamp from the viewpoint of the central station. 3500 w Cent Sta—Jan., 1910. No. 10722.

Signal Systems.

Signal Systems in Large Generating Stations (Signal- u. Verständigungsvorrichtungen in grossen Kraftwerken). Herbert Kyser. Describes apparatus for signalling between boiler and engine rooms. Ills. 2000 w. Elek Kraft u Bahnen—Dec. 4, 1909. No. 11204 D.

Switchboards.

An Experimental Switchboard for Technical Institutions. R. M. Archer. Describes a switchboard designed by the author, explaining its advantages and uses. 3000 w. Elect'n, Lond—Dec. 24, 1909. No. 10634 A.

A Large Industrial Plant Switchboard. Warren H. Miller. Illustrates and describes the controlling devices for a gas engine generating equipment. 2500 w. Elec Wld—Jan. 27, 1910. Serial. 1st part. No. 11205.

LIGHTING.

Arc Lamps.

The Present Status of the Arc Lamp for Street and Interior Illumination. N. R. Birge. Information of illumination and cost, and comparison of d. c. and a. c. arcs. Diagrams. 800 w. Elec Age—Dec., 1909. No. 10543.

Counter Electromotive Force in the Electric Arc. C. D. Child. Abstract of an article in the *Phys. Rev.* Reviews the literature on the subject, and refers to the confusion of meanings. 1200 w. Elect'n, Lond—Dec. 31, 1909. No. 10748 A.

Illumination.

The Principles of Shades and Reflectors. Dr. Louis Bell. A discussion of some of the general principles on which the use of shades and reflectors depends. 4000 w. Elec Age—Dec., 1909. No. 10540.

Daylight Efficiency of Artificial Illuminants. Herbert E. Ives. An investigation to determine whether it might be possible to imitate daylight by the use of globes or screens, and whether the white light obtained might be used as a measure of the quality of an artificial light. 4500 w. Bul Bureau of Stand—Nov., 1909. No. 11169 N.

New Theater, New York City. N. M. Schoonmaker. Illustrates and describes the electrical equipment and illumination of this fine theater in New York City. 5000 w. Elec Wld—Jan. 6, 1910. No. 10839.

Construction of the Floor Illumination Curve from the Curve of Light Intensity (Konstruktion der Bodenbeleuchtungskurven aus der Lichtstärkekurve). J. Sumec. Demonstration of method of determining the illumination of the floor for any position of lamp. Ills. 1500 w. Elektrotech u Maschinenbau—Dec. 5, 1909. No. 11208 D.

Incandescent Lamps.

The Latest Methods of Manufacturing Metallic Lamp Filaments. B. Duschnitz. Abstract translation from *Elektrotechnischer Anzeiger*. Descriptive review of methods used. 1800 w. Elec Rev, N. Y—Jan. 1, 1910. Serial. 1st part. No. 10590.

The Testing of Incandescent Lamps. A. J. Hitzker. Information concerning the tests made by manufacturers to determine the quality and performance of types. 1200 w. Minn Engr—Jan., 1910. No. 11156 C.

Recent Improvements in Incandescent Lamps. F. W. Willcox. Reviews briefly the present incandescent lamp and its method of manufacture and describes the new metal filament lamps. Discussion. 5000 w. Pro Engrs' Club of Phila, No. 1075—Oct., 1909. No. 11161 D.

Tungsten Lamps for Residence Illumination. Charles T. Phillips. Information relating to the economy possible by the use of these lamps, and the greater efficiency. 1200 w. Elec Rev, N Y—Jan. 8, 1910, No. 10716.

Incandescent Filament Lamp Ratings: "Watts" v. "Candle Power." S. M. Powell. Favors the "candle power" for specifying the performance of electric lamps. 1500 w. Elec Rev, Lond—Jan. 14, 1910. No. 11109 A.

The Calculation of Voltages for a Special Arrangement of Incandescent Lamp. Roscoe Scott. States the conditions and gives the solution. 500 w. Elec Wld—Jan. 27, 1910. No. 11208.

The Determination of the Temperature of the Filaments of Incandescent Lamps. L. Crouch. Discusses the need of a more reliable measurement of filament temperatures, and the possible accuracy by the development of resistance-temperature laws for the materials. 700 w. Elec Rev, Lond—Jan. 7, 1910. Serial. 1st part. No. 10895 A.

A Study of Radiation in Metallic-Filament Lamps (Etude du Rayonnement des Lampes à incandescence à Filament métallique). MM. Féry and Cheneveau. Describes, and gives the results, of an elaborate research. Ills. 14000 w. Bul Soc Int des Elecns—Dec., 1909. No. 11005 F.

See also Rates, under GENERATING STATIONS.

We supply copies of these articles. See page 970.

Mercury Arc.

White Light from the Mercury Arc and Its Complementary. Herbert E. Ives. Records an experimental investigation of the proper light source to be combined, with the mercury arc in order to imitate average day light. 2000 w. Bul Bureau of Stand—Nov., 1909. No. 11172 N.

Street.

Street Lighting. Dr. Lewis Bell. Discusses some of the things needed to make it sound in practice. 3500 w. Munic Engng—Jan., 1910. No. 11193 C.

Street Lighting in the City of New York. H. Thurston Owens. Gives tabulated statistics and illustrated description. 1800 w. Elec Rev, N Y—Jan. 1, 1910. No. 10589.

MEASUREMENT.

Electrodynamometers.

See Hysteresis, under MEASUREMENT.

Hysteresis.

The Testing of Sheet Steel for Magnetic Circuits. H. Clyde Snook. Illustrates and describes a method of testing steel in sheets for use in laminated magnetic circuits. Discussion. 2000 w. Pro Engrs' Club of Phila, No. 1077.—Oct., 1909. No. 11163 D.

The Ballistic Electrodynamometer and the Testing of Iron. M. E. Rice and B. McCollum. Abstract from *Phys. Rev.* Describes a method of testing the hysteresis loss using a special electrodynamometer. 1500 w. Elec'n, Lond—Jan. 14, 1910. No. 11112 A.

Meters.

Electric Meters and the Sale of Electrical Energy (Les Compteurs et la Vente de l'Energie électrique). Ch. Fabry. The first instalment begins a description of meters of various types. Ills. Serial. 1st part. 4500 w. Tech Mod—Dec., 1909. No. 11016 D.

Transformer Testing.

Determinination of Constants of Instrument Transformers. F. A. Laws. Outlines a method for determining the current ratio of a series transformer involving the use of the potentiometer principle; also describes a special form of strip electrodynanometer and its use. 1200 w. Elec Wld—Jan. 27, 1910. No. 11296.

The Determination of the Constants of Instrument Transformers. P. G. Agnew and T. T. Fitch. The principle of the method described is the same for both current and potential transformers, being an application of the potentiometer method. 3500 w. Bul Bureau of Stand—Nov., 1909. No. 11174 N.

POWER APPLICATIONS.

Agriculture.

Electricity on the Farm. Illustrates and describes European applications of electric power to agricultural operations. 1800 w. Elec Wld—Jan. 6, 1910. No. 10840.

Heating.

Electrically Heated Household Appliances. A. G. Jones. Shows the importance to the central station of developing the electric heating business, giving applications of heating and cooking devices. 2200 w. Elec Engr, Lond—Dec. 24, 1909. No. 10632 A.

Pumping.

Electrically Driven Pumps. An illustrated article giving opinions, experiences and practice of manufacturers and users. 1500 w. Elec Rev, N Y—Jan. 8, 1910. Serial. 1st part. No. 10717.

TRANSMISSION.

Cables.

A Proposed Definition of the Electrical Characteristics of Conductors (Vorschläge für die Definition der elektrischen Eigenschafen gestreckter Leiter). H. Diesselhorst and F. Emde. Considers the general case of a many-wire cable. Mathematical. Ills. 4000 w. Elektrotech u Maschinenbau—Dec. 5, 1909. No. 11209 D.

Conduits.

Construction of Electrical Conduits. Illustrated account of early underground conduits, the materials now used and descriptions of construction work at various places. 2500 w. Munic Jour & Engr—Jan. 26, 1910. No. 11230.

Comparative Methods and Costs of Underground Conduit Construction. Clarence Mayer. Compares methods and costs of constructing underground conduits for electric transmission lines and railway signal lines. 3300 w. Engng-Con—Jan. 5, 1910. No. 10820.

Line Design.

Calculation of Lines Between Street Railway Power Stations. Ralph H. Rice. Explains a method that has been found satisfactory in practice. 1500 w. Elec Ry Jour—Jan. 8, 1910. No. 10656.

Lines.

Transmission Lines of the Central Colorado Power Company. Illustrated description of methods used in transmitting energy at high voltage and high altitudes. 3000 w. Elec Wld—Jan. 27, 1910. No. 11294.

Recent Development in Secondary Distribution Work. W. K. Vanderpoel. Short descriptions of relatively new practices which have particularly affected the problem of secondary distribution. Ills. 4000 w. Elec Age—Dec., 1909. No. 10542.

Three-Phase.

The Heyland Diagram and Three-Phase Transmission (Das Heylanddiagramm, und über die Drehstromkraftübertragung). Conrad Irangi. A review of three-phase transmission practice. Serial. 1st part. 1200 w. Elektrotech Rundschau—Dec. 22, 1909. No. 11203 D.

Transformers.

Some Phases of Transformer Regula-

tion. W. A. Hillebrand and S. B. Charters, Jr. Based on experiments conducted at Stanford University upon the regulation of transformers under varying conditions. 3500 w. Pro Am Inst of Elec Engrs—Jan., 1910. No. 11249 F.

The Regulation of Potential Transformers and the Magnetizing Current. M. G. Lloyd and P. G. Agnew. Shows that the magnetizing current has no appreciable effect on the regulation of potential transformers. 1800 w. Bul Bureau of Stand—Nov., 1909. No. 11173 N.

Cooling Media Temperature in Soft Iron Stampings. R. D. Gifford. Abstract of paper read before the Birmingham Sec. of the Inst. of Elec. Engrs. Describes a research made to determine the conductivity to heat flow existing between the surface of a cylinder made up of soft iron stampings and such cooling media as air and oil under stated conditions. Ills. 5000 w. Elec Engr, Lond—Jan. 14, 1910. Serial. 1st part. No. 11106 A.

See also A. C. Dynamos, under Dynamos and Motors.

MISCELLANY.

Accidents.

Employer's Liability from an Electrical Viewpoint. Sidney W. Ashe. Discusses electrical accident cases, their causes and the question of liability. 1500 w. Elec Wld—Jan. 6, 1910. No. 10842.

Fire Risk.

The Examination of Electrical Installations for Insurance Purposes (Revisionen elektrischer Anlagen zu Assekuranzzwecken). Frederick Drexler. Discusses a number of practices contributing to the danger of fire. 2200 w. Elektrotech u Maschinenbau—Dec. 19, 1909. No. 11212 D.

Magnet Steel.

Magnet Steel and Permanent Magnetism. Abstract translation of an article by G. Mars, in *Stahl und Eisen*, giving résumé of the results of experimental work. 1200 w. Elec Wld—Jan. 20, 1910. No. 10947.

Marseilles Congress.

The Marseilles Congress (1908) on Applied Electricity. Outlines the contents of some of the principal papers presented. 3500 w. Elec'n, Lond—Dec. 31, 1909. No. 10745 A.

Standardization.

Standardization Rules of the American Institute of Electrical Engineers. Dr. C. P. Steinmetz. Lecture before the Schenectady Section, A. I. E. E. Explains the advantages of standardization, the measurement of efficiency, test requirements, value of the rules, etc. 5000 w. Ir Trd Rev—Jan. 20, 1910. No. 10928.

INDUSTRIAL ECONOMY.

Accounting.

A System for Recording and Accounting for Supplies and Labor in the Paving Division of a City Street Department. A system suggested by Samuel Whinery in a recent report upon the street department of Boston, Mass. 3000 w. Engng-Con—Dec. 29, 1909. No. 10549.

Apprenticeship.

The Grand Trunk Shop Apprentice System. Information from a pamphlet issued by the railway. The system has been in successful operation for a number of years. 1500 w. Ry Age Gaz—Jan. 7, 1910. No. 10698.

A Successful System of Apprenticeship. F. A. Halsey. Explains features and gives results of General Electric Co.'s plan of training mechanics. 5500 w. Am Mach—Vol. 33, No. 1. No. 10738.

Cost Systems.

Cost Accounting. Elijah W. Sells. From an address before the Nat. Assn. of Agri. Imp. & Veh. Mfrs. Outlines features of a modern cost system. 2000 w. Jour of Acc—Jan., 1910. No. 11144 C.

Education.

The Training of Men—A Necessary Part of a Modern Factory System. Magnus W. Alexander. Explains the educational policy and methods of the General Electric Co., at the Lynn, Mass., shops. 6000 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11245 F.

Co-operative Industrial Education. E. F. Du Brul. Abstract of a supplementary report of the Committee on Industrial Education to Nat. Assn. of Mfrs. 2500 w. Am Mach—Vol. 33, No. 3. No. 10956.

Trade Schools in Public School System. P. Kreuzpointher. Discusses the relation of the school to industrial and trade education. 4500 w. Am Mach—Vol. 33. No. 2. No. 10855.

Architectural Education in America. A. D. F. Hamlin. An interesting review of conditions in America affecting artistic development and the agencies and schools that have trained American architects. Discussion. 18500 w. Jour Ry Inst of Brit Archts—Dec. 18, 1909. No. 11231 D.

Is the Engineer School Necessary? R. R. Raymond. Discusses the uses and abuses of the graduate school for the instruction of engineer officers after their graduation from West Point, with an editorial on "Civil Engineers in River and Harbor Work." 5000 w. Eng News—Jan. 27, 1910. No. 11287.

We supply copies of these articles. See page 970.

The English Universities and Engineers. A survey of what has been done during the last five years for the education of engineers. 3500 w. Engr, Lond—Dec. 24, 1909. No. 10643 A.

Employer's Liability.

See Accidents, under ELECTRICAL ENGINEERING, MISCELLANY.

Engineering.

The Profession of Engineering. Jesse M. Smith. Presidential address, 1909. Historical review of societies of engineers. 2500 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11242 F.

Engineering and Art. Julian Chase Smallwood. On the value of the scientific use of the imagination. 1700 w. Cassier's Mag—Jan., 1910. No. 11187 B.

Engineering Ethics.

See same title, under MINING AND METALLURGY, MINING.

Germany.

Economic Problems in Germany (Volkswirtschaftliche Fragen der Gegenwart). Heinrich Macco. Discusses population, taxation, transportation and other present-day problems of importance. 10000 w. Stahl u Eisen—Dec. 15, 1909. No. 11053 D.

Management.

Organization by Production Factors. A. Hamilton Church. This fifth article of a series considers the method of apportioning indirect expense by production factors. 4500 w. Engineering Magazine—Feb., 1910. No. 11239 B.

The Principles of Business Management of an Architect's Office Practice. H. S. Kissam. A discussion of office systems and organization. 4000 w. Sch of Mines Qr—Nov., 1909. No. 11167 D.

Improving Production Conditions in a Modern Boiler Factory. H. S. Knowlton. Discusses methods for the elimination of waste. 2000 w. Engineering Magazine—Feb., 1910. No. 11235 B.

Efficiency in Shop Operations. H. F. Stimpson. Aims to show what efficiency is, how it may be measured and developed, and the results its cultivation will produce. 2500 w. Iron Age—Jan. 6, 1910. No. 10610.

Minimum Wage.

The Minimum Wage (Le Salaire Minimum). Maurice Bellom. Points out the dangers of the system, citing the example of England. 3500 w. Génie Civil—Dec. 18, 1909. No. 11034 D.

Municipal Government.

The Boston Experiment in Municipal Government. Editorial discussion of the effect of important charter amendments. 2000 w. Eng News—Jan. 20, 1910. No. 10966.

Natural Resources.

President Taft's Message on Internal Improvements. Statements of importance in their bearing on engineering work, with editorial comment. 3000 w. Eng Rec—Jan. 22, 1910. No. 10970.

Three Kinds of Conservation. Editorial discussion of the opposing elements in the U. S. Congress, and of features referred to in the President's message. 1600 w. Eng News—Jan. 20, 1910. No. 10965.

Conservation and the Chemical Engineer. Sam. P. Sadtler. Presidential address before the Am. Inst. of Chem. Engrs. in Phila. Discusses the discovery and exploitation as preceding conservation, and points out how the chemical engineer can aid in the conservation of industries. 3500 w. Met & Chem Engng—Jan., 1910. No. 10823 C.

New Zealand.

The Natural Resources of New Zealand. W. Wilson. Brief description of the country and discussion of its mineral, agricultural, and commercial resources. Ills. 4000 w. Cassier's Mag—Jan., 1910. No. 11186 B.

Patents.

Some Hardships of Patent Interference. L. P. Alford. States facts to show the hardships the United States patent system imposes. 4500 w. Am Mach—Vol. 33. No. 3. No. 10955.

Public Utilities.

Work of the New York Public Service Commissions. Summaries of the features of most interest to engineers, as taken from the report for 1909. 3000 w. Eng News—Jan. 27, 1910. No. 11288.

Relative Economy.

A Method of Determining Relative Economy with Rules and Tables for Practical Computation. S. S. Roberts. An outline of rules in use, giving convenient tables based on them, and explaining their use. 2500 w. Engng-Con—Jan. 19, 1910. No. 10944.

Stores Keeping.

Stores Keeping (Aus der Praxis der Lagerverwaltung). Alexander Rothert. Describes methods and forms for accounting for material. Ills. 2500 w. Tech u Wirt—Dec., 1909. No. 11214 D.

Trusts.

A Comparison of the American Coal and Steel Trusts with the German Coal and Iron Syndicates (Ein Vergleich des amerikanischen Trustsystems der Kohlen- und Eisenindustrie mit den deutschen Kohlen- und Eisen-Syndikaten). Herr Pilz. An elaborate comparative discussion of the working of the two systems. 7500 w. Glückauf—Dec. 4, 1909. No. 11062 D.

Wage Systems.

The Compensation of Workmen. H. L. Gantt. A study of the conditions of labor efficiency. This first number discusses the principles underlying the bonus system. 4000 w. Engineering Magazine—Feb., 1910. No. 11266 B.

We supply copies of these articles. See page 970.

MARINE AND NAVAL ENGINEERING.

Battleships.

The Brazilian Battleship "Minas Geraes." Describes the disposition of the guns, their mounting, armor protection, propelling machinery, steam trials, gun trials, etc. Ills. 6000 w. Engng—Jan. 21. 1910. No. 11384 A.

Cable Ships.

A New Cable Ship. Illustrated description of the Telconia. 1200 w. Engr, Lond—Dec. 24, 1909. No. 10644 A.

Colliers.

The U. S. Colliers Mars, Vulcan and Hector. Illustrated descriptions of recently completed vessels. 2500 w. Int Marine Engng—Jan., 1910. No. 10600 C.

Cruisers.

The New British Scout Cruisers. Information relating to the new vessels and their equipment, and the guaranteed performance of the different types of machinery. 1500 w. Engr, Lond—Jan. 21, 1910. No. 11397 A.

Ferryboats.

The Swedish Train Ferry Drottning Victoria. F. C. Coleman. Illustrated description of an interesting vessel for service on the Baltic Sea. 1000 w. Int Marine Engng—Jan., 1910. No. 10597 C.

Fishing Vessels.

An Investigation of the Causes of Loss of Fishing Steamers (Untersuchung über die Ursachen des Unterganges der verschollenen Fischdampfer). Frederich Moll. Examines the causes of casualties at sea. Ills. Serial. 1st part. 3500 w. Schiffbau—Dec. 8, 1909. No. 11073 D.

Marine Transport.

Holyhead as a Port of Call. Discusses the effect on the mails and passenger traffic of recent changes in the routes of transatlantic vessels. Ills. 2000 w. Engr, Lond—Jan. 14, 1910. No. 11129 A.

Motor Boats.

The Motor Yacht Igloo. Illustrated description of a modern type of cruising power boat. 1500 w. Naut Gaz—Jan. 13, 1910. No. 10782.

How to Build a Falcon, a Fast Thirty-three Foot Runabout. Frederick K. Lord. An illustrated description of the plans and construction. 3000 w. Rudder—Jan., 1910. Serial. 1st part. No. 10567 C.

Propellers.

Building a Novel Propeller Wheel Pattern. F. W. Barrows. Illustrates and describes details in constructing the blade, etc. 1800 w. Am Mach—Vol. 33. No. 4. No. 11277.

Safety.

The General Conditions of Security in Sea-Going Vessels (Conditions générales de la Sécurité de la Navigation Maritime). A report of the discussion at the Eleventh International Navigation Congress, St. Petersburg, 1908. 5500 w. Ann d Ponts et Chaussées—1909-VI. No. 11082 E + F.

Shipbuilding.

Shipbuilding and Marine Engineering in 1909. A review of this industry in the United Kingdom. 8000 w. Engng—Dec. 31, 1909. No. 10754 A.

Progress of Warships and Machinery Under Construction in England. On the progress of the latest new constructions in the Royal dockyards. 2500 w. Engr, Lond—Jan. 14, 1910. No. 11127 A.

The World's Naval and Merchant Shipbuilding. Review of the official record of Lloyd for the year 1909, with comparison with earlier years. 2500 w. Engng—Jan. 21, 1910. No. 11393 A.

Changes in English Steel Sections for Shipbuilding (Die Umwälzung in den englischen Schiffbauprofilen). Carl Kielhorn. A discussion of the new English standard sections. 2500 w. Stahl u Eisen—Dec. 8, 1909. No. 11051 D.

See also Machine Tools, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Ship Reconstruction.

Record Work in Lengthening the Steamship Howard. An illustrated account of work carried out at Erie Basin. Brooklyn, N. Y. 2000 w. Marine Rev—Jan., 1910. No. 10884.

Steam Boilers.

Steam-Yacht with Boilers for Oil Fuel. Illustrated description of steam machinery for a steam yacht of nearly 20 tons displacement. 1000 w. Engng—Jan. 21, 1910. No. 11388 A.

Steam Engines.

See Condensers, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Steamships.

The New Queensborough and Flushing Mail Steamers. Illustrated description of recently built vessels of the cross-channel class, the new twin-screw steamers Princes Juliana, Oranje Nassau, and Mecklenburg. 3000 w. Engng—Jan. 14, 1910. No. 11124 A.

Submarines.

Modern Submarine Torpedo Boats. R. S. Bayard. Illustrated detailed description of boats of the Holland type and their action. 2500 w. Am Mach—Vol. 33. No. 4. No. 11279.

Submarine Signals.

Submarine Sound Signals. Information published by the U. S. Hydrographic Office, reviewing past and present achievements. 3500 w. Sci Am Sup—Jan. 8, 1910. No. 10671.

We supply copies of these articles. See page 970.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Accessories.

Things That Attract in the Accessory Field. A general review of accessory exhibits at the Madison Sq. show. Ills. 9000 w. Automobile—Jan. 6, 1910. No. 10727 C.

Bearings.

See Ball Bearings, under MACHINE ELEMENTS AND DESIGN.

Carburetors.

Novelties in Carburetors and Fuel Systems at the Madison Square Garden Show. Albert L. Clough. Brief description of exhibits. 2000 w. Horseless Age—Jan. 19, 1910. No. 10995.

Carburetors at the Show. Charles E. Duryea. A descriptive review of forms exhibited. 2000 w. Horseless Age—Jan. 5, 1910. No. 10783.

How Carbureter Problems Are Solved. An illustrated review of changes shown, illustrating and describing types. 2000 w. Automobile—Jan. 13, 1910. No. 10849.

Cartercar.

The 1910 Cartercar. Illustrates and describes the new vehicle and its parts. 1200 w. Horseless Age—Dec. 29, 1909. No. 10546.

Clutches.

Clutch Slipping; Its Purposes and Effects. Albert L. Clough. Explains the philosophy of clutch slipping. 2500 w. Horseless Age—Dec. 29, 1909. No. 10545.

Commercial Vehicles.

On the Question of Motor Car Services (Subject XV for Discussion at the Eighth Session of the Railway Congress). J. C. Inglis. Report on porterage, cartage and connecting services by motorcar. Ills. 8400 w. Bul Int Ry Cong—Dec., 1909. No. 11264 G.

Wanamaker Stores' Unique Loading System. Harry W. Perry. Illustrates and describes the inner body used in Packard trucks which facilitate loading and unloading. 1800 w. Com Veh—Jan., 1910. No. 10592 C.

Commercial Vehicles at Madison Square Garden. Illustrated descriptions of some models to be shown. 5000 w. Com Veh—Jan., 1910. No. 10594 C.

Commercial Vehicles at Grand Central Palace. Illustrates and describes interesting exhibits. 5000 w. Com Veh—Jan., 1910. No. 10593 C.

Construction.

Pressed Steel Solves Intricate Problems. Thomas J. Fay. An illustrated article discussing the applications and value of this material in automobile construction. 7500 w. Automobile—Jan. 13, 1910. No. 10847.

Novelties in Bodies at the Auto Show. H. H. Brown. Illustrates and describes interesting exhibits shown in New York City. 1800 w. Horseless Age—Jan. 12, 1910. No. 10794.

Precision in Production the Theme. Thomas J. Fay. The advantages of association, as shown in the product and methods, are discussed. Ills. 7500 w. Automobile—Jan. 6, 1910. (Special No.) No. 10724 C.

Control.

Standardization of Control Systems as Observed at the Show. Chester S. Ricker. Reviews points in control systems observed at the New York exhibition. 1200 w. Horseless Age—Jan. 5, 1910. No. 10786.

Right Hand versus Left Hand Control for Automobiles. W. F. Davidson. Gives arguments for and against the different controls. 1500 w. Horseless Age—Dec. 29, 1909. No. 10544.

Darracq.

Small Cars of 1910. The present number describes the Darracq Fourteen-Sixteen. Ills. 1400 w. Auto Jour—Jan. 15, 1910. No. 11105 A.

Delaunay-Belleville.

An Imperial Delaunay-Belleville. Illustrated description of the latest motor car for the Czar of Russia. 1700 w. Autocar—Jan. 1, 1910. No. 10777 A.

Design.

Distinguishing Features Found in 1910 Product. Thomas J. Fay. An illustrated review of improvements noticed in the latest automobile models. 6000 w. Automobile—Jan. 6, 1910. (Special No.) No. 10723 C.

Electric.

Electrics Extending Scope of Usefulness. Thomas J. Fay. Reviews the development of electric vehicles. Ills. 2500 w. Automobile—Jan. 6, 1910. (Special No.) No. 10725 C.

Gas-Producer Plant vs. Central-Station Service for Charging Electric Vehicles. Roderick D. Donaldson. Gives a comparison of cost based upon data from practical operation. 1200 w. Elec Wld—Jan. 20, 1910. No. 10948.

Central-Station Experience with Electric Vehicles. Gives comparative records of the operation of electric and horse vehicles showing the former to be cheaper. 2000 w. Elec Wld—Jan. 13, 1910. No. 10838.

Everitt.

The "Everitt 30" for 1910. Illustrated description of this design. 1800 w. Automobile—Jan. 20, 1910. No. 10992.

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Exhibitions.

The Story of A. M. C. M. A. Show. An illustrated report of the tenth exhibition, held at Madison Sq. Garden, New York City. 3000 w. Automobile—Jan. 6, 1910. No. 10726 C.

Farm Vehicles.

What the Motor Vehicle Is Doing for the Farmer. Walter Langford. Illustrates and describes vehicles found useful. 2000 w. Sci Am—Jan. 15, 1910. No. 10798.

Fire Apparatus.

Automobile Fire Engines. Herbert T. Wade. Illustrates and describes modern automobile fire apparatus. 2500 w. Sci Am—Jan. 15, 1910. No. 10800.

Gears.

Two, Three or Four Gears? Albert L. Clough. Presents arguments for the different speeds, discussing their applications. 1500 w. Horseless Age—Jan. 5, 1910. No. 10790.

Ignition.

Tendencies in Ignition Practice. Albert L. Clough. Gives impressions gained by visits to the Palace and Garden shows in New York City. 1500 w. Horseless Age—Jan. 12, 1910. No. 10791.

Ignition Methods Assume Definite Form. Brief illustrated descriptions of systems used in automobiles. 1200 w. Automobile—Jan. 13, 1910. Serial. 1st part. No. 10851.

Ignition Novelties at the Shows. Albert L. Clough. Brief illustrated descrip- New York City. 1500 w. Horseless Age—Jan. 12, 1910. No. 10793.

Lighting.

Lighting by Latest Electric Methods. Thomas J. Fay. An illustrated article discussing improvements in methods of driving dynamos and other features of the electric lighting of automobiles. 1800 w. Automobile—Jan. 13, 1910. No. 10846.

The Lighting Situation as Revealed by the Shows. H. H. Brown. Reviews the marked features in the illumination of cars. 1600 w. Horseless Age—Jan. 12, 1910. No. 10792.

Locking Devices.

Anti Joy Ride Devices. Harry Wilkin Perry. Illustrates and describes mechanical devices invented to prevent unauthorized use of cars. 6000 w. Sci Am—Jan. 15, 1910. No. 10797.

Motors.

Types of Power Plants. Illustrated discussion of types as utilized in automobiles. 1500 w. Automobile—Jan. 13, 1910. No. 10848.

Simplicity the Keynote of Engine Design. Illustrated review of the tendencies in design exhibited in the motors shown at the London and New York exhibitions. 1000 w. Horseless Age—Jan. 5, 1910. No. 10785.

Repairing.

How to Overhaul a Car. Herbert L. Towle. Detailed directions, with illustrations. 2500 w. Sci Am—Jan. 15, 1910. No. 10799.

In the Garage Repair Shop. Thomas J. Fay. Suggestions for repairs. Ills. 2500 w. Automobile—Jan. 20, 1910. Serial. 1st part. No. 10993.

Review of 1909.

Progress in the Automobile Field in 1909 (Les Progrès de l'Automobilisme en 1909). F. Drouin. An illustrated review. 3200 w. Génie Civil—Dec. 18, 1909. No. 11033 D.

Singer.

The 16-20 h. p. Singer. Illustrated description of a 4-cylinder 4-speed car, and recent improvements. 1000 w. Autocar—Jan. 15, 1910. No. 11104 A.

Speedometers.

Speedometers, Odometers and Taximeters at the Show. H. H. Brown. Brief illustrated review. 700 w. Horseless Age—Jan. 5, 1910. No. 10787.

Springs.

The Design of Automobile Springs. Egbert R. Morrison. An illustrated article explaining principles, deducing general formulæ, and considering the subject generally. 3500 w. Mach, N Y—Jan., 1910. No. 10578 C.

Steering Gears.

Modern Practice in Motor Car Steering. George E. Goddard. Notes on the two principal systems of steering linkages. Ills. 1800 w. Horseless Age—Jan. 5, 1910. No. 10788.

Taximeters.

See Speedometers, under AUTOMOBILES.

Tires.

Tires, Rims and Tire Sundries at the Show. H. H. Brown. An illustrated descriptive review of interesting exhibits. 2000 w. Horseless Age—Jan. 5, 1910. No. 10784.

Tractors.

Suggestions on the Design and Selection of Traction Engines. Points from a paper by W. F. MacGregor, read before the Soc. of Agri. Engrs.' considering the elements entering into the ideal tractor and discussing traction engine practice. 2000 w. Engng-Con—Jan. 12, 1910. No. 10822.

Transmission Stresses.

The Stresses in Transmission Parts. F. E. Watts. Considers the causes and effects of stresses in the transmitting parts of a motor car. 2000 w. Horseless Age—Jan. 5, 1910. No. 10789.

Wheels.

Wheels, Rims and Tires. Brief illustrated descriptions of details of various makes shown this year. 2000 w. Automobile—Jan. 13, 1910. No. 10850.

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COMBUSTION MOTORS.

Aeronautic Motors.

The Design of Aeroplane Engines. Examines the differences between the requirements of a car or boat and those of an aeroplane, and discusses the number of cylinders, their arrangement, and other details. 4000 w. Engng—Jan. 7, 1910. No. 10911 A.

Gas Engines.

Combustion Motors (Les Moteurs à Combustion). L. Letombe. Develops a general theory of combustion motors with a view to determining the possibility of obtaining a higher thermal efficiency. Ills. 2200 w. Tech Mod—Dec., 1909. No. 11019 D.

Efficiency Test of Otto Gas Engine. C. C. Winn. Reports a test at Purdue University for determining the most economical speed, under a given load. 600 w. Power—Jan. 11, 1910. No. 10768.

A Device for Single-Acting, Four-Cycle Gas Engines (Dispositif cinématique pour Moteurs à Gaz à simple Effet, quatre Temps). E. L. Doaré. A discussion of the kinematics of the gas engine, suggesting a device to permit of complete expansion. Ills. 1000 w. Rev de Mécan—Dec., 1909. No. 11226 E + F.

Notable Gas-Engine Installations in Continental Europe. A series of illustrations with descriptive captions. Engineering Magazine—Feb., 1910. No. 11236 B.

Large Gas-Engine Construction in America (Der Grossgasmaschinenbau in Amerika). Herr Rieppel. A comprehensive review of American practice. Ills. Serial. 1st part. 4500 w. Zeitschr d Ver Deutscher Ing—Dec. 11, 1909. No. 11217 D.

See also Blowing Engines, under MINING AND METALLURGY, IRON AND STEEL.

Gas Power Plants.

Small Isolated Producer Gas Plant. Osborn Monnett. Illustrates and describes an installation. Convenient arrangement for coal handling. 800 w. Power—Jan. 11, 1910. No. 10766.

Recent Development of the Producer Gas Power Plant in the United States. Robert Heywood Fernald. Information regarding installations, tests, efficiencies, reliability, cost, etc. Ills. 27000 w. U. S. Geol Surv—Bul. 416. No. 11142 N.

Gas Producers.

Notes on Combustion. Nisbet Latta. Discusses the efficiency of the gas producer and two-stage combustion. 4000 w. Cassier's Mag—Jan., 1910. No. 11188 B.

Bituminous Producers (Neuere Generatoren für bituminöse Brennstoffe). Herr Gwosdz. A review of a number of recent types. Ills. 3500 w. Glückauf—Dec. 11, 1909. No. 11064 D.

Ignition.

The Electric Ignition of Internal Combustion Engines. J. W. Warr. Discusses the systems used. Diagrams. 2000 w. Prac Engr—Jan. 14, 1910. Serial. 1st part. No. 11118 A.

Oil Engines.

A New Oil Engine of Remarkably High Economy. Description of the De La Vergne machine, explaining its advantages, and giving results of tests. Ills. 1400 w. Eng News—Jan. 13, 1910. No. 10811.

HEATING AND COOLING.

Air Humidifying.

Use of Humidifiers in a Cold Climate. Brief illustrated description of the heating and ventilation of the American Optical Co.'s administration building at Southbridge, Mass. 800 w. Heat & Vent Mag—Jan., 1910. No. 11138.

Central Plants.

Central Steam Distribution from Hilltop. Illustrated description of a central system supplying a number of buildings at Johnson City, Tenn. 4000 w. Met Work—Jan. 15, 1910. No. 10876.

Distant Heating and Hot-Water Supply Plant for the Taunus Officers' Barracks at Falkenstein (Die Fernheizung und Fernwarmwasserversorgung für das Offizierheim Taunus zu Falkenstein i.T.). J. Ritter. Detailed description of the system. Ills. 3000 w. Gesundheits-Ing—Dec. 25, 1909. No. 11091 D.

Electric Heating.

See Heating, under ELECTRICAL ENGINEERING, POWER APPLICATIONS.

Hot-Air Heating.

Report of the Review Committee for 1910 on Furnace Heating. 4500 w. Am Soc of Heat & Vent Engrs—Jan., 1910. No. 11261 N.

Warming and Ventilating a High-Class Residence. Describes an indirect system with a battery of furnaces, ventilated by an exhaust of air from each room. 1500 w. Met Work—Jan. 15, 1910. No. 10877.

Hot-Water Heating.

Errors in Piping Double Boiler Connections. Explains the importance of making correct connections, showing the proper way. 1500 w. Met Work—Jan. 8, 1910. No. 10707.

A Method of Determining the Sizes of the Pipes of a Hot-Water Apparatus. J. Jeffreys. Diagram and explanation of method employed. 3500 w. Am Soc of Heat & Vent Engrs—Jan., 1910. No. 11260 N.

Heating by Hot Water Under Difficulties. An unusual overhead down feed system of hot water distribution is illustrated and described. 2000 w. Met Work—Jan. 15, 1910. No. 10875.

Pipe Bending.

Bending Copper Tubes. J. Wright Clarke. Drawings and description of methods. 2000 w. Plumb & Dec—Jan. 1, 1910. No. 10894 A.

Public Buildings.

The Warming and Ventilation of Public Buildings and Factories. T. W. Aldwinckle. Read before the Assn. of Engrs.-in-Charge. Deals with general principles, illustrating by examples. 2500 w. Archt, Lond—Jan. 14, 1910. Serial. 1st part. No. 10999 A.

Refrigeration.

Refrigeration. The present number describes the carbonic anhydride system. Ills. 800 w. Prac Engr—Dec. 31, 1909. Serial. 1st part. No. 10772 A.

The Flooded System. H. Rassbach. On the flooded system and its application to ice making and refrigerating plants. 6000 w. Ice & Refrig—Jan., 1910. No. 10711 C.

Modern Cold Storage and Refrigeration. W. S. Douglas. Refers to the uses to which refrigeration is applied, and discusses the methods of design in vogue, the materials, etc. 3000 w. Archt, Lond—Jan. 7, 1910. Serial. 1st part. No. 10893 A.

The Ice Factory of the Future. Victor H. Becker. Read at Chicago meeting of the Am. Soc. of Refrig. Engrs. A criticism of the ice plant of the present, and the writer's views concerning the future plant. 4000 w. Ice & Refrig—Jan., 1910. No. 10712 C.

The Industrial Production of Cold (Production industrielle de la Frigorie). Léon Lefebvre. A brief review of types of refrigerating machines. Ills. 4500 w. Tech Mod—Dec., 1909. No. 11021 D.

See Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS; and Refrigeration, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Steam Heating.

Simple Office Building Heating Plant. The heating arrangements for the 12-story Terminal Building, 41st St. & Park Ave., New York, are illustrated and described. 1500 w. Met Work—Jan. 15, 1910. No. 10874.

Ventilation.

A Remarkable Theatre Ventilating Plant. Illustrates and describes features of design and operation of the Nuremberg theatre, which are contradictory to prevailing practice in the United States. 7500 w. Met Work—Jan. 15, 1910. No. 10873.

See Hot-Air Heating, under HEATING AND COOLING.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

The Design, Construction and Operation of Centrifugal Pumps. Franz zur Nedden. This second article discusses solutions of the problem of balancing axial thrust. Ills. 3000 w. Engineering Magazine—Feb., 1910. No. 11269 B.

The High-Pressure Fire-Service Pumps of Manhattan Borough, City of New York. Discussion of the paper by Prof. K. C. Carpenter. Ills. 9000 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11246 F.

The Balancing of Axial Thrust in Centrifugal Pumps (Ueber das Auftreten von achsialen Drücken sowie deren Beseitigung bei Zentrifugalpumpen). Emil Gutmann and Ludwig Weil. Discusses the conditions giving rise to axial thrust and methods of prevention. Ills. Serial. 1st part. 2500 w. Zeitschr d Oest Ing u Arch Ver—Dec. 24, 1909. No. 11200 D.

See also Pumping Plants, under HYDRAULIC MACHINERY; and Vacuum Pumps, under STEAM ENGINEERING.

Electric Pumping.

See Pumping, under ELECTRICAL ENGINEERING, POWER APPLICATIONS.

Pumping Plants.

Blackpool Sea Water Supply Works. Illustrated detailed description of this pumping plant in which three electrically driven centrifugal pumps have recently been installed. 1000 w. Engr, Lond—Jan. 14, 1910. No. 11131 A.

Steam-Driven Pumping Plant for Deep Wells and Boreholes. Alfred Towler. Read before the Assn. of Water Engrs. Considers the class of plant where the engine is out of suction distance from the water to be pumped. Ills. 2200 w. Mech Wld—Jan. 7, 1910. Serial. 1st part. No. 10909 A.

Pumps.

Pumps and Compressors with a New Valve Construction (Pumpen und Kompressoren mit einer neuen Ventilkonstruktion). O. Klepal. Describes the new valve and illustrates its application to pumps and compressors. Ills. 3600 w. Zeitschr d Ver Deutscher Ing—Dec. 18, 1909. No. 11220 D.

Safety Valves.

Hydraulic Safety Valves (Konstruktion hydraulischer Sicherheitsventile). Eduard Müller. Discusses the construction of safety valves for hydraulic machinery. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Dec. 25, 1909. No. 11223 D.

Turbine Design.

A Rational Method of Determining the Principal Dimensions of Water-Turbine Runners. S. J. Zowski. Mathematical demonstration. 3500 w. Eng News—Jan. 6, 1910. No. 10622.

Turbine Pipe Lines.

Notes on Allievi's Theory of Pressure Variations in Pipe Lines (Bemerkungen zur Allievi'schen Theorie der Druckschwankungen in Rohrleitungen). Dr. E. Braun. Mathematical discussion of papers on the subject by Allievi in *Revue de Mécanique*, and by Rateau in *Die Turbine*. 2000 w. Die Turbine—Dec. 5, 1909. No. 11074 D.

We supply copies of these articles. See page 970.

Turbine Plants.

See Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Turbine Speed.

The Specific Speed of Hydraulic Turbines (Ueber die spezifische Umlaufzahl von Wasserturbinen). R. Neeser and R. Sigmund. Mathematical discussion. Ills. 2000 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 30, 1909. No. 11086 D.

Turbine Tests.

The Testing of Hydraulic Turbines (Essai des Turbines hydrauliques). J. Izart. A brief discussion of testing methods and apparatus. Ills. 3000 w. L'Elecn—Dec. 11, 1909. No. 11028 D.

Water Wheel Testing.

The Application of the Pitot Tube to the Testing of Impulse Water-Wheels. William Rankine Eckart. Briefly considers the methods available for measuring the discharge from large nozzles under high heads, and describes experiments with the Pitot tube under actual power-plant conditions. Ills. 8500 w. Inst of Mech Engrs—Jan. 7, 1910. No. 11121 N.

MACHINE ELEMENTS AND DESIGN.

Annular Rings.

The Strength of Circular Rings and Half-Rings (Resistance d'Anneaux et de Demi-Anneaux circulaires). A. Rauber. Establishes general formulae for their calculation. Ills. 4000 w. Rev de Mécan—Dec., 1909. No. 11224 E + F.

Ball Bearings.

Two Race Ball Bearings. Asher Golden. Discusses the defects of this class of bearings. Ills. 1500 w. Horseless Age—Jan. 12, 1910. No. 10795.

Industrial Applications of Ball Bearings (Applications industrielles des Roulements à Billes). Abstract of a paper by M. Carles. Discusses friction losses in manufacturing plants and the economy of substituting ball for ordinary bearings in power generating and transmitting apparatus. 3000 w. Rev d'Econ Indus—Dec. 16, 1909. No. 11003 D.

Cams.

Some Interesting Cam Constructions. Edward Person. Gives a cam chart and different methods of laying out cams. 1000 w. Mach, N Y—Jan., 1910. No. 10586 C.

Clutches.

Experimental Analysis of a Friction Clutch-Coupling. William T. Magruder. Reports a series of experiments made to determine results from the application of a known force at the end of the shifter lever of a friction clutch-coupling. 3500 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11243 F.

Couplings.

Analysis of Various Modern Types of Elastic Couplings (Analisi e Calcolo di alcuni Collegamenti elastici odierni). Ottorino Pomini. Mathematical discussion of the design of elastic couplings. Ills. Serial. 1st part. 3000 w. Industria—Dec. 19, 1909. No. 11041 D.

Flywheels.

Safe Speeds for Cast Iron Flywheels. Information from the Fidelity & Casualty Co.'s book on "The Prevention of Industrial Accidents." Gives method of determining the safe speed. 800 w. Power—Jan. 25, 1910. No. 11101.

Gears.

Gears with Spherical Teeth (Zur Frage der Kugelzahnräder). August Bauschlicher. Discusses their advantages and illustrates various constructions and application. Serial. 1st part. 3500 w. Zeitschr d Mit Motorwagen Ver—Dec. 15, 1909. No. 11092 D.

Graphical Charts.

See same title, under CIVIL ENGINEERING, MISCELLANY.

Stresses.

Resistance of Steels to Repeated Alternate Stresses. James E. Howard. Read at the Int. Assn. for Test. Mat. Gives results of tests, and remarks on the behavior of steel under different conditions. 1500 w. Mech Engr—Dec. 31, 1909. No. 10774 A.

Compound Stress Experiments. C. A. M. Smith. Gives experimental results obtained upon solid steel bars subjected to compound or combined stress, indicating the methods used. Ills. 6000 w. Inst of Mech Engrs—Dec. 17, 1909. No. 10638 N.

Mild-Steel Tubes in Compression and Under Combined Stress. William Mason. Describes experimental work on the comparative yield-point strengths in compression and shear. Ills. 5000 w. Inst of Mech Engrs—Dec. 17, 1909. No. 10639 N.

MACHINE WORKS AND FOUNDRIES.

Boring Mills.

Boring and Turning Mills. Illustrates and describes a new line of vertical mills, in five sizes, brought out by the Colburn Co. 1500 w. Am Engr & R R Jour—Jan., 1910. No. 10765 C.

Brazing.

Brazing Plant. Richard N. Hart. Illustrates and describes a brazing outfit that can be installed in large shops, or can be set up in an independent shop. 800 w. Met & Chem Engng—Jan., 1910. No. 10834 C.

Bronze Founding.

Ornamental White Bronze Castings. A. B. Saw. Illustrates and describes how they are made in a foundry making a specialty of zinc statuary. 2500 w. Foundry—Jan., 1910. No. 10563.

See also Foundry Materials, under MACHINE WORKS AND FOUNDRIES.

We supply copies of these articles. See page 970.

Cam Grinding.

Cam Grinding Attachment for the Vertical Surface Grinder. Illustrated description of the principal features of an important attachment and its operation. 1500 w. Am Mach—Vol. 33. No. 4. No. 11275.

Castings.

See Molding Machines, under MACHINE WORKS AND FOUNDRIES.

Cores.

The Core Problem in the Foundry. Jabez Nall. Illustrated description of the use of cores differing from the ordinary practice. 2000 w. Foundry—Jan., 1910. No. 10565.

Cutting Tools.

A Formal Tool Problem. H. V. Purman. States the problem and gives the solution as worked out. Diagrams. 700 w. Mach, N Y—Jan., 1910. No. 10583 C.

Dies.

Punch and Die with Close Fitting Stripper. F. Greiner. Illustrates and describes this type and its operation, explaining its advantages. 2000 w. Am Mach—Vol. 33. No. 2. No. 10853.

Enamelling Furnaces.

Direct-Fired Enamelling Muffle Furnaces (Emaillier-Muffelofen mit direkter Feuerung). Ernst A. Schott. Describes a number of types. Ills. Serial, 2 parts. 3000 w. Giesserei-Zeit—Nov. 15, and Dec. 15, 1909. No. 11058 each D.

Foundries.

Vancouver's New Steel Foundry. The general arrangement and equipment are illustrated and described. 1500 w. Foundry—Jan., 1910. No. 10564.

New Featherstone Foundry, Chicago. Illustrated description of a foundry built for the production of miscellaneous locomotive and car castings. 1500 w. Ry Age Gaz—Jan. 7, 1910. No. 10704.

Foundry Appliances.

Foundry Flask-Pins. Walter J. May. Suggestions for the making and use of flask-pins. 800 w. Prac Engr—Dec. 24, 1909. No. 10628 A.

Foundry Design.

The Design of Modern Iron Foundries (Gesichtspunkte für die Anlage moderner Eisengiessereien). A. Koob. A general discussion of the lay-out of buildings and the choice and arrangement of equipment. Ills. 4500 w. Stahl u Eisen—Dec. 29, 1909. No. 11056 D.

Foundry Materials.

Foundry Coke. A German discussion of the physical structure, melting value, freedom from deleterious matter, etc. 1500 w. Ir Age—Jan. 13, 1910. No. 10845.

The Briquetting of Metal Turnings and Their Value in Iron and Bronze Foundry Practice (Brikettierung von Metallspänen und deren Wert für die Eisen- und Bronze-Giessereien). Oscar Leyde. Discusses the use of metal-turning briquettes as part of the cupola charge. Ills. 4000 w. Stahl u Eisen—Dec. 1, 1909. No. 11048 D.

Gear Cutting.

Formers for Cutting Bevel Gears. Gives an analysis aiming to show that correct bevel gear teeth may be planed by the use of a comparatively small number of formers. 1000 w. Mach, N Y—Jan., 1910. No. 10587 C.

Machine Tools.

Power Tests of Machine Tools. P. V. Vernon. Read before the Coventry Engng. Soc. An account of tests made to determine what each machine would do. Ills. 1500 w. Engr, Lond—Dec. 24, 1909. No. 10648 A.

The Influence of High Speed Steel on Recent Machine Tool Design, and the Possibilities of Existing Designs Which Operators Fail to Realize. O. M. Becker. An illustrated discussion of the development and uses. 3500 w. Ir Trd Rev—Dec. 30, 1909. No. 10524.

Some Special Machine Tools Used in Ship Construction. E. C. Amos. Illustrates and describes some of the latest types used in modern ship work, and in the construction of marine reciprocating engines and turbines. 3500 w. Int Marine Engng—Jan., 1910. No. 10596 C.

Milling Machines.

A Wagon Underframe Milling Machine. Illustrated description of a milling machine designed specially for machining the ends of the sole bars of railway carriage underframes. 800 w. Engr, Lond—Jan. 14, 1910. No. 11132 A.

Molding.

Pipe Moulding. Arthur Greenhalgh. Brief discussion of methods used. Ills. 1200 w. Mech Wld—Dec. 24, 1909. No. 10631 A.

See also Patterns, under MACHINE WORKS AND FOUNDRIES.

Molding Machines.

Machine-Molded Motor Car Castings. C. L. Chase. Illustrated account of how the cost of molding was reduced. 1800 w. Foundry—Jan., 1910. No. 10566.

Molding Sand.

Observations on Foundry Sands (Observations sur les Sables de Fonderie). Henry Le Chatelier. Discusses the compositions of various natural and artificial sands in use in France with a view to finding a satisfactory basis of selection. 3500 w. Rev de Métal—Dec., 1909. No. 11010 E + F.

Patterns.

Pattern and Mold for Chilled Capstan Bell. W. Potter. Illustrated detailed description. 1200 w. Am Mach—Vol. 33. No. 2. No. 10854.

Pipe Founding.

See Molding, under MACHINE WORKS AND FOUNDRIES.

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Planers.

Automatic Reversing-Gear for Electrically-Driven Planing-Machines. Illustrated detailed description. 700 w. Engng—Dec. 31, 1909. No. 10753 A.

Pneumatic Tools.

High-Speed Pneumatic Hammer. Illustrated description of a hammer which can be set to run automatically, designed by the firm of Peter Pilkington, Ltd. 500 w. Engr, Lond—Dec. 31, 1909. No. 10760 A.

Press Tools.

Die-beds or Bolsters for Presses. Discusses their design and construction. Ills. 1200 w. Mach, N Y—Jan., 1910. No. 10582 C.

Safety Appliances.

Practical Safeguards in the National Cash Register Co.'s Plant. Ethan Viall. Illustrates and describes the methods and devices for protecting employees from accidents. 2000 w. Mach, N Y—Jan., 1910. No. 10584 C.

Shop Hygiene.

The Air of Manufacturing and Commercial Establishments (L'Air respirable dans les Locaux industriels et commerciaux). M. Lebrasseur. Discusses the requirements of such places for ventilation and humidifying. 2500 w. Rev d'Econ Indus—Dec. 16, 1909. No. 11004 D.

Shop Practice.

Tools and Methods Used in Making Star Lathes. Illustrates and describes tools and methods introduced at the Seneca Falls Mfg. Co.'s works. 2000 w. Am Mach—Vol. 33. No. 3. No. 10953.

American and European Machine Shop Methods. William H. Dooley. A comparative discussion of the shops and industrial schools. 3500 w. Ir Age—Jan. 13, 1910. Serial. 1st part. No. 10843.

Automobile Factory Practice. Ethan Viall. Illustrated description of methods used by the Nordyke & Marmon Co., Indianapolis, Ind. 2000 w. Mach, N Y—Jan., 1910. No. 10581 C.

Shop Kinks. Gives the first and second prize awards in the January competition of this publication, with others of merit, and editorial. 6000 w. Ry Age Gaz—Jan. 7, 1910. No. 10705.

Chucking and Forming on an Engine Lathe. Duplicate work with the aid of special tools is illustrated and described. 1000 w. Am Mach—Vol. 33. No. 4. No. 11278.

Machining Cylinders and Pistons for Automobile Engines. Harold Whiting Slauson. Illustrates and describes improved shop practice which has greatly increased the efficiency of these engines 3000 w. Mach, N. Y—Jan., 1910. No. 10580 C.

Machining the Component Parts of an 8 H. P. Petrol Engine. Deals in detail with the component parts, showing the jigs and fixtures requisite for mass production. Ills. 1500 w. Mech Wld—Jan. 7, 1910. Serial. 1st part. No. 10908 A.

Machining Methods on an Engine Bed and Parts. S. R. Stone. Illustrates and describes work on large castings. 1000 w. Am Mach—Vol. 33. No. 4. No. 11273.

How to Babbitt a Main Bearing. F. L. Johnson. Illustrated instructions. 1000 w. Power—Jan. 11, 1910. No. 10767.

Lake Shore Method of Casting Driving Bearings in the Box. Description, given by A. O. Berry, of their method of pouring the brass bearing of driving boxes into the steel boxes, thus saving the necessity of slotting the boxes and turning the bearings. Ills. 500 w. Ry Age Gaz—Jan. 7, 1910. No. 10703.

Straightening.

Straightening Hardened Steel Spindles. E. M. King. Describes both unsuccessful and successful methods tried. 1200 w. Am Mach—Vol. 33. No. 4. No. 11274.

Tempering.

Hardening Carbon Steels. H. Ralph Badger. Explains the effect of composition, and of heat treatment, and the hardening process. Ills. 3500 w. Mach, N Y—Jan., 1910. No. 10585 C.

Use of Compounds in the Hardening of Steel. C. U. Scott. A report of tests and statement of facts in regard to heat treatment. 2500 w. Am Mach—Vol. 33. No. 2. No. 10857.

Electrically Heated Oil-tempering Baths. H. Fulwider. Illustrates and describes the construction and gives methods of oil-tempering. 1500 w. Wood Craft—Jan., 1910. No. 10680.

Welding.

New Gas Fusion Process. Charles R. King. An account of a German improvement on the oxyhydric process. 1600 w. Sci Am Sup—Jan. 8, 1910. No. 10673.

Welding Cast Iron (Ueber das Schweissen des Gusseisens). E. Lamberton. Discusses electric and thermit welding. Ills. 3500 w. Stahl u Eisen—Dec. 29, 1909. No 11057 D.

MATERIALS OF CONSTRUCTION.

Alloy Steels.

Steel for Cutters, Punches, and Dies. U. C. Perar. Information concerning the high chromium steel used in France for casting into milling cutters, punches, etc. Ills. 2500 w. Am Mach—Vol. 33. No. 1. No. 10740.

A contribution to the Study of Special Ternary Steels (Contribution à l'Etude des Aciers speciaux ternaires). A. Portevin. Reports a research to determine the effect of the third metal on the mechanical and electrical properties of various ternary iron alloys. Ills. 36000 w. Rev de Métal—Dec., 1909. No. 11011 E + F.

We supply copies of these articles. See page 970.

Brass.

See Testing Methods, under MEASUREMENT.

Bronze.

See Testing Methods, under MEASUREMENT.

Copper.

General Principles for Copper Specifications (Principes généraux pour les Conditions de Réception du Cuivre). Léon Guillet. A report to the Int. Assn. for Testing Mats. on standards of quality for copper wire, bars, tubes and plates for use in Electrical and locomotive work. 2500 w. Rev de Métal—Dec., 1909. No. 11008 E + F.

Metallography.

A Contribution to the Study of Tempered Steels (Contributo alle Studio degli Acciari temprati). Gino Gallo. A discussion of their metallographic composition. 3000 w. Ann d Soc d Ing e d Arch Ital—Dec. 15, 1909. No. 11037 F.

Tool Steels.

See Machine Tools, under MACHINE WORKS AND FOUNDRIES; and Alloy Steels, under MATERIALS OF CONSTRUCTION.

Wire Rope.

The Flexibility of Wire Ropes. R. W. Chapman. Discusses the testing of forces required to bend wire ropes. 1000 w. Engng—Jan. 7, 1910. No. 10916 A.

MEASUREMENT.

Bakelite.

Bakelite, a Condensation Product of Phenols and Formaldehyde, and Its Uses. Dr. Leo H. Backeland. Reviews the mode of preparation and describes applications of this material. 1500 w. Jour Fr Inst—Jan., 1910. No. 11199 D.

Dynamometers.

6000 Horse-power Absorption Dynamometer. Illustrated detailed description of the new dynamometer designed to determine the efficiency of the Melville-Macalpine gearing. 2000 w. Am Mach—Vol. 33. No. 2. No. 10852.

6000 H. P. Absorption Dynamometer. Illustrates and describes how the principle of the reversed turbine is used in the solution of a new problem in water brake design. 2000 w. Power—Jan. 4, 1910. No. 10606.

Gas Meters.

An Electric Gas Meter. Carl C. Thomas. Addition given orally to paper (No. 9800) presented before the Society at the Dec. meeting. 800 w. Jour Am Soc of Mech Engrs—Jan., 1910. No. 11244 F.

Gauge Testing.

Gage Repairs. Allen G. Wood. Gives suggestions practicable for making a test apparatus, and for its use. 1200 w. R R Age Gaz—Dec. 31, 1909. No. 10555.

Impact Tests.

Report on the Testing of Metals by Impact (Rapport sur les Essais de Métaux par Choc). G. Charpy. A general discussion of the impact test before the Int. Assn. for Testing Mats. Ills. 8000 w. Rev de Métal—Dec., 1909. No. 11007 E + F.

The Fragility of Metals and the Impact Test (La Fragilité des Métaux et les Essais au Choc). G. Charpy. Includes, besides the text of the report presented by the author to the Int. Assn. for Testing Mats., a review of other reports bearing on the subject and an abstract of the discussions. Ills. Serial. 1st part. 4200 w. Tech Mod—Dec., 1909. No. 11017 D.

Micrometer Scale.

A Measuring and Dividing Scale and Its Applications (Die Mess- und Teilschiene und ihre Anwendung). A. Wagener. Illustrated description of a new device particularly useful for the accurate measurement of diagram areas. 3500 w. Zeitschr d Ver Deutscher Ing—Dec. 18, 1909. No. 11221 D.

Planimeters.

The Hatchet Plainimeter. H. R. Edgecomb. Illustrated description of the improved instrument and its use. 1200 w. Am Mach—Vol. 33. No. 1. No. 10741.

Pyrometers.

Selecting and Using Pyrometers. C. Conam. Suggestions for selecting pyrometers for the control of furnace temperatures. 1500 w. Am Mach—Vol. 33. No. 1. No. 10743.

An Adjustable Pyrometer-Stand. L. W. Bahney. Brief illustrated description. 600 w. Bul Am Inst of Min Engrs—Jan., 1910. No. 11255 F.

Platinum Resistance Thermometry at High Temperatures. C. W. Waidner and G. K. Burgess. An account of an investigation undertaken to determine the advantages and limitations of platinum resistance thermometers at high temperatures. Ills. 15500 w. Bul Bureau of Stand—Nov., 1909. No. 11168 N.

The Laws of Heat Radiation (Les Lois du Rayonnement calorifique). Ch. Féry. Discusses the basis of the theory of radiation pyrometers. Ills. 2500 w. Bul Soc d'Encour—Dec., 1909. No. 11227 G.

Tachometers.

The Hutchison Electrical Tachometer. Illustrated description of a design for indicating at any number of distant points the exact rate of rotation, or the lineal speed of any shaft or machine. 1700 w. Ir Age—Jan. 27, 1910. No. 11271.

Testing Methods.

Applications of Modern Methods of Testing to Copper Alloys (Applications des Méthodes d'Essais modernes aux Alliages de Cuivre). Léon Guillet and Louis Révillon. A report to the Int. Assn. for Testing Mats., giving results of hardness, shear and impact tests on brasses and bronzes of various compositions. 2200 w. Rev de Métal—Dec., 1909. No. 11009 E + F.

We supply copies of these articles. See page 970.

POWER AND TRANSMISSION.

Air Compressors.

Compound Air Compressor Cylinder Ratios. Snowden B. Redfield. Diagrams and discussion showing the best ratio for economy is equal work. 2500 w. Am Mach—Vol. 33. No. 3. No. 10957.

The Rateau Centrifugal Air Compressors and Blowers. Frank Koester. Illustrates and describes the latest developments in compressor practice. 1800 w. Eng News—Jan. 20, 1910. No. 10963.

See also Pumps, under HYDRAULIC MACHINERY.

Belts.

Strength of Leather Belts. Y. Sekiguchi. Gives tabulated results of investigations. 500 w. Mech Engr—Jan. 14, 1910. No. 11117 A.

Compressed Air.

Engine Driving by Compressed Air. Snowden B. Redfield. A study of the air, power and coal required using reheat, cut off and expansion. 5000 w. Am Mach —Vol. 33. No. 2. No. 10856.

Cost.

The Most Economical Power for Small and Medium-Sized Iron and Steel Works. J. A. Kneseche. A comparison of steam, electric, and gas power as applied to existing plants. Ills. 7000 w. Ir Trd Rev —Jan. 6, 1910. No. 10686 D.

Electric Driving.

Advantages of Electric Drive. J. E. Bullard. Arguments for the power solicitor. 2500 w. Elec Rev, N Y—Jan. 22, 1910. No. 10994.

Line Shaft Drive and Individual Motor Drive in Machine Shops. A. G. Popcke. A comparison of analysis made of experimental tests, favoring the motor drive. 2000 w. Elec Jour—Jan., 1910. No. 11160.

The Electric Motor in Printing Work. S. H. Sharpsteen. Describes applications to print-shop auxiliaries. 3000 w. Elec Wld—Jan. 27, 1910. No. 11297.

Electric Driving in Engineering Workshops. S. G. Winn. Suggestions in regard to the best method to adopt in installing an electric drive. 2200 w. Mech Wld—Dec. 31, 1909. No. 10776 A.

The Electrical Driving of a Lead Works. An illustrated article giving an account of results of installing the electric drive in works at Hepburn-on-Tyne. 2000 w. Engr, Lond—Dec. 24, 1909. No. 10645 A.

See also Economics, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Mechanical Plants.

The Economics of Heating and Lighting Plants for Sanatoria (Die Rentabilität der Heizungs- und Beleuchtungsanlagen von Heilanstalten mit eigenen Kraftbetrieben). Herr Tilly. Examines the cost of various systems of heating and lighting for an institution accommodating 1,600 persons. Ills. 3000 w. Gesundheits-Ing—Dec. 4, 1909. No. 11089 D.

Rope Driving.

Rope-Driving. J. Stormonth. Calls attention to features that need attention in difficult drives. 2500 w. Engng—Dec. 31, 1909. No. 10749 A.

STEAM ENGINEERING.

Boiler Economy.

See Heat Transmission, under STEAM ENGINEERING.

Boiler Explosions.

The Shelton Boiler Explosion. F. R. Low. An illustrated analysis of rupture, starting with large seam crack. 1000 w. Power—Jan. 4, 1910. No. 10601.

Boiler Explosion at Reading, Penn. Warren O. Rogers. Illustrated description of a 40-hp. vertical boiler explosion, discussing the cause. 1600 w. Power—Jan. 25, 1910. No. 11100.

Kansas City Boiler Explosion. Edward H. Lane. Illustrated account of a disastrous explosion, probably caused by a stop-valve between boiler and safety valve. 1500 w. Power—Jan. 18, 1910. No. 10878.

Boiler Failures.

Board of Trade Reports on Boiler Failures. An epitome of the more important cases reported. Ills. 2500 w. Mech Engr —Jan. 14, 1910. No. 11116 A.

Boiler Fittings.

High and Low Water Alarms for Boilers. W. H. Wakeman. Illustrated descriptions of various types, with suggestions for their location and connection. 3000 w. Power—Jan. 4, 1910. No. 10607.

High and Low Water Alarms for Boilers. W. H. Wakeman. Illustrated descriptions of various types of apparatus. 4500 w. Power—Jan. 25, 1910. No. 11103.

Boiler Management.

The Production of Steam (Ueber Dampferzeugung). Herr Kneuse. An examination of the cost of steam in a coal mine power plant economically managed and carefully arranged. 3500 w. Glückauf—Dec. 11, 1909. No. 11063 D.

See also Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Boiler Tests.

Comparative Evaporative Tests of Lancashire and Yorkshire Boilers. A report from the National Boiler and Insurance Co., Ltd., Manchester, Eng., on tests of two Lancashire and one Yorkshire boilers, with editorial remarks. 2500 w. Mech Engr—Jan. 14, 1910. No. 11115 A.

Boiler Waters.

Boiler Feed Waters with Special Reference to Treatment. E. G. Bashore. A résumé of conditions as met with in practice with reference to treatment of boiler waters. 2500 w. Met & Chem Engng—Jan., 1910. No. 10828 C.

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Feed Water System of the New York Edison Company. Illustrated description of the system at the new Waterside power station for the handling and conservation of the boiler-water supply. 1200 w. Eng Rec—Jan. 1, 1910. No. 10520.

Condensers.

Condensing Plant of Novel Design. Frederick Ray. Illustrated description of the condenser equipment at the Saucon plant of the Bethlehem Steel Co. 2000 w. Power—Jan. 4, 1910. No. 10603.

Marine Condenser Installations (Kondensationsanlagen für Schiffe). Paul L. Hahn. A brief discussion of the design of condenser plants for marine steam turbines. Ills. 2200 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1909. No. 11085 D.

Engine Governors.

Hunting on High-Speed Engine Governors. H. Keay Pratt. Explains how to stop hunting. Ills. 1200 w. Mech Wld—Jan. 7, 1910. No. 10907 A.

Fuel Oil Burners.

Suggestions for a Fuel Oil Burner. H. B. Stilz. Illustrates and describes a design in which the oil is heated to such an extent before entering the nozzle that enough vapor is formed to atomize the remainder of the oil in the furnace. 800 w. Power—Jan. 25, 1910. No. 11102.

Fuel Purchasing.

Fuel Supply Contracts on a Heat-Unit Basis. John B. C. Kershaw. Discusses practical difficulties which may arise in carrying out this method, and how they may be overcome. 2500 w. Elec Rev, Lond—Jan. 7, 1910. No. 10896 A.

Fuels.

A Detailed Study of Practical Fuel Values. W. P. Young. Abstract of a paper read before the W. Va. Coal Min. Inst. Gives information of value relating to fuels. 1800 w. Eng & Min Jour—Jan. 1, 1910. No. 10537.

Fuel Tests.

Fuel Tests with House-Heating Boilers. J. M. Snodgrass. Describes 130 fuel tests with house-heating boilers, with discussion of results. Ills. 22000 w. Univ of Ill, Bull No. 31—Feb. 22, 1909. No. 11140 N.

Heat Transmission.

Heat Transmission and Fuel Economy. P. J. Pringle. Describes some experiments carried out with Lancashire boilers, investigating the flue side of the boiler. 2000 w. Elec Rev, Lond—Jan. 14, 1910. No. 11108 A.

Indicator Diagrams.

Indicating a Steam Pipe. Diagrams taken with an ordinary indicator screwed into a steam pipe at different positions, and actuated from the engine cross-head by a cord, with notes. 500 w. Engr, Lond—Jan. 14, 1910. No. 11128 A.

Oil Separators.

Turbo Oil-Separator. Describes the action and gives an illustrated description of a new English design. 800 w. Engng—Dec. 24, 1909. No. 10641 A.

Smoke Prevention.

Smoke Prevention in Steam Boiler Plants. H. D. Frary. This first of two articles considers the principles of smoke prevention and their practical application. 5000 w. Minn Engr—Jan., 1910. No. 11155 C.

An Investigation of the Smoke and Soot Problem in Hamburg (Bericht über die in Hamburg ausgeführten Rauch- und Russuntersuchungen). Dr. Kister. A report on the study of smoke prevention. Ills. Serial. 1st part. 6600 w. Gesundheits-Ing—Dec. 18, 1909. No. 11090 D.

Stacks.

Stacks for Water-Tube Boilers. T. F. J. Maguire. Gives data of draft, and formulæ for design. 3000 w. Engineering Magazine. Feb., 1910. No. 11238 B.

See also same title, under CIVIL ENGINEERING, CONSTRUCTION.

Steam Consumption.

Rateau's Diagram of Steam Consumption. W. C. Way and H. F. Schmidt. Gives diagram and explanation. 400 w. Power—Jan. 4, 1910. No. 10602.

Steam Piping.

High Pressure Steam Piping. Perry West. Plans and description of schemes used in the arrangement of piping for power plants. 2500 w. Power—Jan. 18, 1910. No. 10879.

High Pressure Steam Piping. Perry West. Considers typical systems and schemes for power plant work. 2500 w. Heat & Vent Mag—Jan., 1910. Serial. 1st part. No. 11139.

Steam Properties.

A New Formula for the Total Heat of Steam. Robert H. Smith. Commending the new set of steam tables prepared by Prof. L. S. Marks and H. N. Davis, and the formula presented. 1200 w. Engr, Lond—Dec. 24, 1909. No. 10646 A.

Superheating.

The Theory of Superheating. Considers the three theories for the economy secured by superheating steam between the boiler and engine. 2500 w. Engr, Lond—Dec. 31, 1909. No. 10758 A.

Turbine Design.

The Calculation of Turbine Discs (Berechnung von Radscheiben). Huldreich Keller. Mathematical demonstration of an analytical method. Ills. 3000 w. Die Turbine—Dec. 5, 1909. No. 11075 D.

Turbine Governing.

An Investigation of the Influence of the Adjustment of the Governor on Turbine Governing (Untersuchung der Wirkungsweise der Regelungberichtigung bei der Regelung von Turbinen). A. Renard. An

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exhaustive theoretical discussion of the regulation of turbines. Ills. Serial. 1st part. Die Turbine—Dec. 20, 1909. No. 11076 D.

Turbine Operation.

The Utility of Thermometers for Recording the Temperature of Steam Placed in the Steam Pipe Leading to Each Turbine (Remarques sur l'Utilité des Thermomètres enregistreurs de la Temperature de Vapeur placés sur la Conduite d'Admission de chaque Turbine). V. Lebeau. Ills. 1500 w. All Indus—Dec., 1909. No. 11022 D.

Turbines.

Recent Brown, Boveri & Co. Steam Turbines (Neuere Dampfturbinen der Firma Brown, Boveri & Co.). Illustrates and describes late machines built by this firm. Serial. 1st part. 1000 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1909. No. 11084 D.

Vacuum.

The Most Economical Vacuum in Power Stations Employing Steam Turbines and Cooling Towers. R. M. Neilson. Abstract of paper before the Glasgow Sec. of the Inst. of Elec. Engrs. Explains how the most economical vacuum can be ascertained for each load factor. 1500 w. Elec'n, Lond—Jan. 14, 1910. No. 11111 A.

Vacuum Pumps.

The Centrifugal Wet-Vacuum Pump. H. R. Callaway. Compares the advantages of the direct driven centifugal with reciprocating type for circulating and hotwell service. Ills. 1500 w. Power—Jan. 4, 1910. No. 10605.

Valve Gears.

Setting Corliss Valve Gears. G. J. Reynolds. Explains simple method of setting valve gear on single and double eccentric Corliss engines. Ills. 2000 w. Power—Jan. 4, 1910. No. 10604.

TRANSPORTING AND CONVEYING.

Coal Handling.

Sewalls Point Coal Pier. F. F. Harrington. Illustrated description of apparatus handling ten to fifteen thousand tons of coal per day. 3000 w. Mines & Min—Jan., 1910. No. 10568 C.

Coal Handling Installations in Geneva Harbor (Outillage pour la Manutention du Charbon dans le Port de Gênes). Illustrated description of coal-unloading plants. 5000 w. Génie Civil—Dec. 25, 1909. No. 11035 D.

Cranes.

Waygood's Electric and Hydraulic Luffing Wharf-Cranes. Illustrates and describes two cranes of the pedestal form, with power to lift, slew, and luff. 1200 w. Engng—Jan. 7, 1910. No. 10915 A.

Elevators.

The Stopping of Lifts. F. O. Hunt. Calls attention to defects in brake gear of passenger elevators, and to an improvement shown in a recent patent. 1200 w. Elec Rev, Lond—Jan. 7, 1910. No. 10897 A.

MISCELLANY.

Aeronautics.

Aeronautics. Charles Cyril Turner. A lecture on the principles and development of aeronautical science. 7000 w. Jour Soc of Arts—Dec. 24, 1909. Serial. 1st part. No. 10624 A.

Aerial and Marine Navigation (Luftschiffahrt und Seeschiffahrt). F. v. Hoefft. An attempt to elucidate some of the problems of aeronautics by a comparison with submarine navigation. 4000 w. Zeitschr d Oest Ing u Arch Ver—Dec. 24, 1909. No. 11201 D.

Financial Mechanics of Aviation. M. C. Krarup. Considers some mechanical ideas of interest in the study of aviation. 1200 w. Am Mach—Vol 33. No. 3. No. 10954.

Concavity in the Planes of Aeroplanes (Sur la Forme concave à Donner à la Voilure d'un Aéroplane du Côté du Bord d'Attaque). F. Chaudy. A mathematical discussion of M. Soreau's theory of the proper form of aeroplane planes. Ills. 2000 w. Mem Soc Ing de France—Oct., 1909. No. 11068 G.

The Paris Exhibition of Aerial Locomotion. I. W. Chubb. An illustrated review of the monoplanes, biplanes and other exhibits. Also of engines for airships. 6000 w. Am Mach—Vol. 33. No. 1. No. 10739.

The Latest Type of Zeppelin Rigid Dirigible (Le dernier Type de Dirigeable rigide "Zeppelin"). Illustrated description. 2000 w. Génie Civil—Dec. 11, 1909. No. 11031 D.

The Parseval Airship (Das Parseval-Luftschiff). An illustrated detailed study. 3500 w. Schweiz Bau—Dec. 11, 1909. No. 11071 B.

German Airship Sheds. Illustrates and describes sheds constructed for the housing of dirigibles. 1200 w. Sci Am Sup—Jan. 8, 1910. No. 10674.

Distilling Apparatus.

The Vallat Distillation System and Apparatus (Procédés et Appareils de Distillation, Système Vallat). J. Vinsonneau. Describes the apparatus and reports records of performance. Ills. Serial. 1st part. 1800 w. Rev Indus—Dec. 18, 1909. No. 11030 D.

A New Type of Distillation Machinery. Walter E. Lummus. Illustrated description of a Lummus multiple-product distillation machine and its operation and applications. 1400 w. Met & Chem Engng—Jan., 1910. No. 10832 C.

Mechanical Engineers.

The Scope and Duties of the Mechanical Engineering Department. Oscar E. Perrigo. Shows how the work of the me-

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chanical engineer has been enlarged and developed during recent years. 7500 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10688 D.

Shoe Machinery.

The Growth of Boot and Shoe-Making Machinery. A. Chaplin. Lecture to the Glasgow Tech. Col. Sci. Soc. Illustrated detailed description of early machines used, and the progress shown. 3500 w. Engng—Jan. 7, 1910. Serial. 1st part. No. 10914 A.

Textile Machinery.

Weaving Appliances. Frank Nasmith. Describes the essential operative weaving mechanisms and appliances which have been devised for increasing production. Ills. 6000 w. Manchester Assn of Engrs—Jan. 8, 1910. No. 11252 N.

The Processes in Cotton-Spinning. Leon A. Hackett. An outline of the operations in the production of cotton yarn from raw cotton. Ills. 5000 w. Harvard Engng Jour—Jan., 1910. No. 11147 D.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Mine Accident Investigations of the United States Geological Survey. George S. Rice. Information concerning the investigations of coal mine accidents made by order of the U. S. Government. Discussion. Ills. 16500 w. Jour W Soc of Engrs—Dec., 1909. No. 11184 D.

First-Aid Movement for Injured Miners. H. H. Stoek. An illustrated account of methods of training for first-aid service as carried out in the anthracite coal regions. 4000 w. Min Wld—Jan. 1, 1910. No. 10533.

Alabama.

The Coosa Coalfield of Alabama. William F. Prouty. Brief account of this coal field which is estimated to contain 80,000,000 tons of high-grade coal, explaining why it has not been developed. 800 w. Eng & Min Jour—Nov. 6, 1909. No. 9138.

British Columbia.

The Nicola Valley Coal-Field, British Columbia. Milnor Roberts. Brief description of this coal-field and its development. 1500 w. Bul Am Inst of Min Engrs—Jan., 1910, No. 11254 F.

Coal Cutting.

Coal Cutting Machinery. Robert Peele. Illustrates and describes the four classes of coal cutters in use and their operation. 5000 w. Sch of Mines Qr—Nov., 1909. No. 11165 D.

Coke Ovens.

The Simplex By-Product Coke Oven. Illustrated description of an installation of 100 ovens at the Devonshire works of the Staveley Company, Limited, near Chesterfield. Plate. 4000 w. Col Guard—Dec. 24, 1909. No. 10637 A.

Electric Power.

Electricity and Coal Mining. F. C. Albrecht. Read before the W. Va. Coal Min. Inst. Discusses the different kinds of electrical equipment and the conditions to which they are adapted. 6500 w. Mines & Min—Jan., 1910. No. 10571 C.

The Use of Electricity in Fiery Mines. Illustrates and describes the principal characteristics of the best types of modern mining equipment. 5000 w. Ir & Coal Trd Rev—Jan. 7, 1910. Serial. 1st part. No. 10922 A.

Explosions.

Factors in the Chemistry of Coal Mine Explosions. N. W. Lord. Read before the Am. Chem. Soc. Discusses gas, dust, and air as factors, and what chemistry can do to reduce the risks. 5000 w. Min Wld—Jan. 15, 1910. No. 10870.

The Extension Explosion. E. Jacobs. An illustrated account of the explosion of Oct. 5, on Vancouver Island. 1500 w. Can Min Jour—Jan. 1, 1910. No. 10558.

France.

The Blanzy-Auxonne-Ronchamp Coal Basin (Le Bassin houiller Blanzy-Auxonne-Ronchamp). Eugène Léotard. A geological study. Ills. 5600 w. Men Soc Ing Civ de France—Oct., 1909. No. 11069 G.

Mine Fires.

The Production of Carbon Monoxide in Mine Fires (Die Bildung von Kohlenoxydgas bei Grubenbränden). E. Schulz. Discusses the causes of formation of the gas. Ills. 7200 w. Glückauf—Dec. 4, 1909. No. 11061 D.

Mine Inspection.

Mine Inspection in Utah Mines. A. C. Watts. An account of the strict inspection methods of the Utah Fuel Co., to insure enforcement of mine rules. 2000 w. Mines & Min—Jan., 1910. No. 10569 C.

Mining.

The Influence of the Varying Hardness of Coal on Wages (Untersuchung über wechselnde Kohlenfestigkeit and ihren Einfluss auf das Lohnwesen). Herr Hilgenstock. An examination of mining costs in England and Germany. Ills. Serial. 1st part. 4200 w. Glückauf—Dec. 18, 1909. No. 11065 D.

Mining Costs.

Required a New Pair of Glasses. Fred

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C. Keighley. Read before the W. Va. Coal Min. Inst. Explains why the cost sheet does not tell the truth, and suggests gaging mining operations by the profit per acre. 2500 w. Eng & Min Jour—Jan. 1, 1910. No. 10536.

Montana.

Red Lodge and Bear Creek Coal Mines, Montana. J. P. Rowe. Illustrated account of the development of largest producing coal mines in the state. 2000 w. Min Wld—Jan. 8, 1910. No. 10719.

Occluded Gases.

The Occluded Gases in Coal. S. W. Parr and Perry Barker. An outline of experimental work, describing apparatus used and methods, and discussing results. 7500 w. Univ of Ill, Bul No. 32—March 1, 1909. No. 11141 N.

Reviews of 1909.

Coal Mining in the United States in 1909. A review of the mining conditions in the important centers of production of both anthracite and bituminous coal. 9000 w. Eng & Min Jour—Jan. 8, 1910. No. 10737.

The Coal Fields of the Southern States. Edward W. Parker. An estimate of their area and contents, with a review of the past and possibilities of future production. 3500 w. Mfrs' Rec—Jan. 6, 1910. (Special No.) No. 10676 C.

Coal Mining in the Middle West. George H. Cushing. A report of conditions during 1909, of both the coal and natural gas industries. 2000 w. Min & Sci Pr—Jan. 15, 1910. No. 10932.

Coal Production in United States Shows Increase. E. W. Parker. Reports the year's production in the various fields. 2500 w. Min Wld—Jan. 22, 1910. No. 10981.

The Coal Trade of 1909. Reports on the coal trade of Northumberland, Durham, Lancashire and Cheshire, West Yorkshire, South Yorkshire and other districts. 32000 w. Col Guard—Jan. 7, 1910. No. 10910 A.

The Coal and Coke Trades of the United Kingdom in 1909. General review and district reviews. 21500 w. Ir & Coal Trds Rev—Dec. 31, 1909. No. 10761 A.

Scotland.

The Coalfields of the Carboniferous Limestone Series, in Lanarkshire, Renfrewshire, and Ayrshire. David Ferguson. Abstract of a paper before the Glasgow Univ. Geol. Soc. describing these deposits. 3000 w. Col Guard—Dec. 31, 1909. Serial. 1st part. No. 10770 A.

Transportation.

See Freight Cars, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Washington.

Coal Screening and Washing Plant with Coking Coal Bunkers at the Bergmannsglueck Colliery of the Royal Mining Inspection III. at Buer in Westphalia. Illustrates and describes a washery recently placed in service. Plate. 2500 w. Ir & Coal Trds Rev—Jan. 7, 1910. No. 10920 A.

Water Clarification.

The Clarification of Waste Mine Waters in the Ems District (Klärung von Zechenabwassern im Emschergebiet). Herr Köhne. Describes the conservation of the water supply in this district by purification of water from the mine, the washing plants. The ammonia works, etc. Ills. 4300 w. Glückauf—Dec. 24, 1909. No. 11067 D.

COPPER.

Alaska.

Copper Deposits of Prince William Sound, Alaska. U. S. Grant. Map and description of the deposits. 1500 w. Min & Sci Pr—Jan. 1, 1910. No. 10667.

Blast-Furnace Slags.

Some Analyses of Copper Blast Furnace Slags and Determination of Their Melting Points. A. T. French. Explains methods of analysis adopted and the results of the work. 1500 w. Inst of Min & Met, Bul. 64—Jan. 13, 1910. No. 11234 N.

British Columbia.

Mine and Mill of Le Roi No. 2, Ltd., Rossland. Roy Hutchins Allen. Illustrated description of the mine plant and equipment, the mill system, etc. 2000 w. Eng & Min Jour—Jan. 15, 1910. No. 10868.

The Center Star Group of Mines, Rossland, B. C. Roy Hutchins Allen. Deals with the geology, vein system, mining methods, etc. 3000 w. Eng & Min Jour—Jan. 1, 1910. No. 10538.

California.

The East Side of the Shasta Copper Belt. A. H. Martin. Describes the formation and the methods of mining and milling. 1500 w. Min Wld—Jan. 15, 1910. No. 10872.

Extraction.

Process of Obtaining Metals from Their Ores. Alexander T. Elliott and Albert Miller. Describes a new process with special reference to a copper oxide ore containing some gold, illustrating apparatus. 2000 w. Min Wld—Jan. 15, 1910. No. 10871.

Lake Superior.

Lake Superior Copper Mining, 1909. Robert H. Maurer. A review of the year, which exceeds all others in the production of copper. Map and Ills. 3300 w. Min & Sci Pr—Jan. 1, 1910. No. 10658.

New Mexico.

Burro Mountain Mining District. I. J. Stauber. An illustrated account of the location, history, geology, operating companies, mines, and extent of development.

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1200 w. Mines & Min—Jan., 1910. No. 10577 C.

Production.

Future of Copper. James Douglas. Discusses the prospects from explored and unexplored fields. 1200 w. Min & Sci Pr—Jan. 8, 1910. No. 10861.

Reverberatory Furnaces.

Oil-Fired Reverberatory Furnace. R. L. Herrick. Explains the method of fettling with selicious ores, the apparatus for burning oil, and gives results of tests. Ills. 2200 w. Mines & Min—Jan., 1910. No. 10574 C.

Reviews of 1909.

The Year 1909 in Copper. H. M. Cole. A review of the production and history of the industry. 2500 w. Ir Age—Jan. 6, 1910. No. 10616.

Record-Breaking Year for the Copper Industry. A review of the production for 1909, and a comparison with earlier years. 1700 w. Min Wld—Jan. 22, 1910. No. 10979.

The Copper Production of North America. Reviews the production of the United States, Mexico and Canada, giving reports of different districts. 8500 w. Eng & Min Jour—Jan. 8, 1910. No. 10729.

Utah.

See Copper, under ORE DRESSING AND CONCENTRATION.

GOLD AND SILVER.

Assaying.

The Detection of Minute Traces of Gold in Country Rock. Arthur R. Andrew. An account of research work by the author, explaining methods and giving results. 2200 w. Inst of Min & Met, Bul 64—Jan. 13, 1910. No. 11233 N.

Chlorination.

The Malm Dry Chlorination Process. R. L. Herrick. Illustrated description of the plant of the Western Metals Company, at Georgetown, Colorado, which is to treat complex ores by this process. 7500 w. Mines & Min—Jan., 1910. No. 10575 C.

Colorado.

Geological Distribution of the Precious Metals in Colorado. T. A. Rickard. The first of a series of articles giving valuable information relating to the ore deposits. Ills. 3500 w. Min & Sci Pr—Jan. 8, 1910. Serial. 1st part. No. 10862.

Cyaniding.

Progress and Development in Cyanide Practice. Mark R. Lamb. Reviews the improvements introduced during 1909. 2000 w. Eng & Min Jour—Jan. 15, 1910. No. 10869.

James' Annual Cyanide Letter. Alfred James. A review of the latest improvements in practice. Ills. 5500 w. Min & Sci Pr—Jan. 1, 1910. No. 10662.

Errors Due to the Presence of Potassium Iodide in Testing Cyanide Solutions for Protective Alkalinity. Bede Collingridge. Brief account of methods used in testing. 500 w. Inst of Min & Met, Bul 64—Jan. 13, 1910. No. 11232 N.

The Cyaniding of Silver-Ores in Mexico. Albert F. J. Bordeaux. Briefly describes the method of cyaniding silver-gold ores, containing very little gold, with special reference to experiments made in the Temascaltepec district. Ills. 3500 w. Bul Am Inst of Min Engrs—J...1., 1910. No. 11258 F.

Cyaniding at the Montgomery-Shoshone Mill. P. Edwin Van Saun. Sands, slimes and concentrates are cyanided separately. Ills. 1500 w. Eng & Min Jour—Jan. 22, 1910. No. 10986.

See also Slimes Treatment, under ORE DRESSING AND CONCENTRATION.

Dredging.

Dredging in Montana and Idaho. W. A. Scott. A report of the gold dredging operations. Ills. 1700 w. Min & Sci Pr—Jan. 1, 1910. No. 10668.

Dredging at Nome in 1909. An illustrated description of dredges in operation and proposed, with a report of the results. 2500 w. Min & Sci Pr—Jan. 1, 1910. No. 10663.

France.

The Gold Mines of France. Jacques Boyer. An illustrated account of their ore deposits, methods of working, and economic importance. 3000 w. Engineering Magazine—Feb., 1910. No. 11268 B.

Hungary.

The Boicza Gold Mines in Hungary. Newton B. Knox. An account of a visit to the Transylvania mines. Ills. 3000 w. Min & Sci Pr—Jan. 1, 1910. No. 10660.

Mexico.

The Santa Gertrudia Mine, Pachuca, Mexico. Excerpts of engineers' reports on the geology, sampling, ore reserves, developments, etc. 2500 w. Eng & Min Jour—Jan. 22, 1910. No. 10985.

Mining Methods and Costs at the Esperanza Mine. W. E. Hindry. Gives a statement of production and costs, with description of methods used. Ills. 2500 w. Min & Sci Pr—Dec. 25, 1909. No. 10529.

The Lluvia de Oro Mine. E. A. H. Tays. Description of a rich mine in Mexico, discovered in 1900. Maps. 1200 w. Min & Sci Pr—Jan. 1, 1910. No. 10666.

Nevada.

The Geological and Physical Condition of Tonopah Mines. Walter P. Jenney Descriptive. 1500 w. Eng & Min Jour—Jan. 1, 1910. No. 10539.

The Geology of the Producing Part of the Tonopah Mining District. J. A. Burgess. Presents an interpretation of the structures of this mining district in Nevada differing materially from that here-

tofore entertained. Considers the district built up of a series of successive lava flows and tuffs. Ills. 7800 w. Ec-Geol—Dec., 1909. No. 11176 D.

Ontario.

The New Porcupine Gold Fields. A. M. Hay. An illustrated account of a visit to these new fields. 1500 w. Can Min Jour—Jan. 15, 1910. No. 10938.

Rand.

Rand Progress in 1909. An illustrated article reporting mining and metallurgical improvements, industrial movements, etc. 3300 w. Min & Sci Pr—Jan. 1, 1910. No. 10664.

Analysis of Mine and Mill Practice on Rand. E. M. Weston. Illustrated discussion of the equipment and operation of the new mills. 4000 w. Eng & Min Jour—Jan. 15, 1910. Serial. 1st part. No 10866.

Reviews of 1909.

The World's Production of Gold and Silver. A review of the production of the past year, comparing with earlier years. 1800 w. Min Wld—Jan. 22, 1910. No. 10978.

Gold, Silver and Platinum in 1909. Review and statement of the production of the three precious metals, with the conditions that influenced their commercial movements and values. 3500 w. Eng & Min Jour—Jan. 8, 1910. No. 10728.

IRON AND STEEL.

Analysis.

The Volumetric Determination of Manganese (Massanalytische Manganbestimmungen). W. Heike. A technical discussion of the various methods. 6300 w. Stahl u Eisen—Dec. 8, 1909. No. 11049 D.

Blast-Furnace Plants.

The Old Torgelow Imperial Iron Works and the Pommeranian Foundry (Das chemals Kgl. Hüttenwerk Torgelow und die vorpommersche Eisengiesserei). A contribution to the history of the German iron industry. Ills. 3000 w. Stahl u Eisen—Dec. 29, 1909. No. 11055 D.

Blast-Furnace Practice.

Some Experiments on Smelting Titaniferous Iron Ore. G. H. Stanley. A reviews of experimental work by the writer and reference also to the work of others. Ills. 7500 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1909. No. 10924 E.

Uniformity of Blast Furnace Operation. Jos. W. Richards. Discusses in detail the efforts to attain greater uniformity. 2200 w. Met & Chem Engng—Jan., 1910. No. 10827 C.

Blowing Engines.

Wooden Cylinders on an Old Blower. E. A. Dixie. Illustrated description of an old blower at Kent, Conn., the last of its kind in New England. 1500 w. Am Mach, Vol. 33. No. 1. No. 10742.

2000-Horse-Power Single-Cylinder Gas Blowing-Engine. Illustrated description of engines recently built at Siegen, Germany. 1000 w. Engng—Dec. 24, 1909. No. 10642 A.

Brazil.

Iron Ore Deposits of Brazil. O. A. Derby. Abstract of report prepared for the International Geological Congress, describing these deposits. 1800 w. Ir & Coal Trds Rev—Jan. 7, 1910. No. 10921 A.

Electrometallurgy.

The Electric Furnace. P. M'N. Bennie. Reviews briefly the progress in the manufacture of iron and steel. 2500 w. Ir Age—Jan. 27, 1910. No. 11272.

The Electric Shaft Furnace at Domnarfvet, Sweden. Abstract of an article by Lars Yngström in *Jern-Kontorets Ann.* An account of the experiments made with this furnace and the conclusions. Ills. 4000 w. Met & Chem Engng—Jan., 1910. No. 10826 C.

A Method of Smelting Iron Ore in the Electric Furnace. Edward R. Taylor. Read before the Am. Inst. of Chem. Engrs. Illustrated description of an electric furnace designed for continuous operation. 2500 w. Ir Trd Rev—Jan. 13, 1910. No. 10860.

The Production of Pig Iron in the Electric Furnace (La Situazione attuale del Forno electrico quale Produttore di Ghise). Emilio Carcano. A review of the present status of this branch of iron metallurgy. Serial. 1st part. 2300 w. Industria—Dec. 19, 1909. No. 11040 D.

The Present Position of Electric Steel Refining. John B. C. Kershaw. Reviews the latest developments in electric furnace working in Europe and America. Ills. 2000 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10687 D.

A New Epoch in Iron Metallurgy and the Iron Industry (Eine neue Epoche im Eisenhüttenwesen und in der Eisenindustrie). Albert Sailler. Discusses the field and possibilities of the electric furnace in steel production. 3200 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 18, 1909. No. 11060 D.

The Girod Furnace and Smelting Plant (Der Girod-Ofen und die elektrischen Schmelzwerke, System Paul Girod). A letter from the Elektrostahl G. m. b. H. criticizing W. Borchers' paper on this subject, with a reply by the latter. Ills. 5000 w. Stahl u Eisen—Dec. 8, 1909. No. 11052 D.

See also Electric Furnaces, under ELECTRICAL ENGINEERING, ELECTRO-CHEMISTRY.

Ferro-Alloys.

The Nature and Uses of Ferro-Silicon. Reviews the report and conclusions of Dr. S. Monckton Coneman, S. R. Bennett and Dr. H. Wilson Hake, on investigations of

the possible dangers arising from the transport and storage of ferro-silicon. 5500 w. Ir & Coal Trds Rev—Jan. 14, 1910. Serial. 1st part. No. 11133 A.

Lake Superior.

Great Achievements on the Iron Ranges. W. I. Bartholomew. A review of the latest mining developments. Ills. 6500 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10685 D.

New York.

The Brewster Iron-Bearing District of New York. F. R. Koeberlin. Gives a descriptive outline of the general geology of the district, describes the mines, prospects, etc., discussing the economic considerations. Ills. 12500 w. Ec-Geol—Dec., 1909. No. 11177 D.

Open Hearth.

A New Process in Iron Metallurgy; Slow-Rusting Iron Produced in the Open-Hearth Furnace. Describes the ingot iron produced recently at Middletown, Ohio, the evolution and results of the process. 5000 w. Eng News—Jan. 6, 1910. No. 10620.

The Open-Hearth Process using Fluid Pig Iron (Einige Bemerkungen über das Martinverfahren mit flüssigem Roheisen). W. Schdanow. Discusses the results obtained at a steel works in Southern Russia. Serial. 1st part. 3500 w. Stahl u Eisen—Dec. 8, 1909. No. 11050 D.

Production.

See Trade, under IRON AND STEEL.

Rolling Mills.

Some Facts Concerning Rolling Mills. Deals with their construction and operation. 1500 w. Prac Engr—Dec. 31, 1909. No. 10771 A.

Rolling Temperatures of Steel. Grant D. Bradshaw. Shows how variations in temperature affects the shape of sections. Ills. 900 w. Ir Age—Jan. 27, 1910. No. 11270.

The Rolling of Special Sections of Iron and Steel. Willis McKee. A discussion of the possibilities and limitations of rolling special sections. Ills. Discussion. 5000 w. Jour W Soc of Engrs—Dec., 1909. No. 11182 D.

Steel Making.

Mechanically Held Impurities in Steel. George Auchy. Discusses a method of eliminating oxide, slag and gases and preventing segregation and piping. 4000 w. Ir Age—Jan. 13, 1910. No. 10844.

Steel Works.

The Works of Messrs. Edgar Allen & Co., Limited, Sheffield. Illustrates and describes interesting features of these important works for the manufacture of steel specialties. 2500 w. Col Guard—Jan. 14, 1910. No. 11119 A.

See also Cost, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Steel-Works' Location.

Location as Affecting Iron and Steel Industries. John Birkinbine. Discusses the effect of location, transportation facilities and conditions affecting the industry. 5000 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10684 D.

Sweden.

The Swedish Iron Industry. Its Present Condition and Prospects. Carl Sahlin. Trans. from *Jernkontoret Annaler*. Discusses the position of this industry, the production, consumption, quality, etc. 3000 w. Ir & Coal Trds Rev—Jan. 14, 1910. No. 11135 A.

Trade.

On Some Causes for Our Declining Steel Trade. From a pamphlet by Benjamin Talbot giving facts and figures bearing on the British steel trade. 3000 w. Ir & Coal Trds Rev—Dec. 24, 1909. No. 10650 A.

The Philadelphia Iron Trade in 1909. August A. Miller. A review of conditions, prices, stocks, etc. 4000 w. Ir Age—Jan. 6, 1910. No. 10613.

Year of Important Events at Pittsburg. Charles J. Stark. A review of leading events in the steel industry. 6000 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10682 D.

The Pittsburg Iron Trade in 1909. Robert A. Walker. A review of the year. 5000 w. Ir Age—Jan. 6, 1910. No. 10611.

Splendid Recovery in the Chicago District. James F. Pendleton. Reviews the iron and steel industry during the past year. 4000 w. Ir Trd Re—Jan. 6, 1910. (Special No.) No. 10683 D.

The Chicago Iron Trade in 1909. R. L. Ardrey. A review of business, prices, new construction, etc. 2500 w. Ir Age—Jan. 6, 1910. No. 10612.

The Cincinnati Iron Trade in 1909. H. E. Hall. A general review of the year. 3000 w. Ir Age—Jan. 6, 1910. No. 10614.

Important Development of a Twelve-Month in the East. B. S. Stephenson. A review of the noteworthy features of the iron and steel trade for 1909. 5000 w. Ir Trd Rev—Jan. 6, 1910. (Special No.) No. 10681 D.

Iron and Steel Industry in 1909. A general review of the production and the more important markets. 8000 w. Eng & Min Jour—Jan. 8, 1910. No. 10731.

The Sheet and Tin Plate Trades in 1909. B. E. V. Luty. A review of the production, prices, etc. 3500 w. Ir Age—Jan. 6, 1910. No. 10615.

LEAD AND ZINC.

Lead Smelting.

Metallurgical Progress in Colorado. Philip Henry Argall. An illustrated review of the changes in the metallurgical processes during the year 1909, reporting work at Cripple Creek, Leadville, Pueblo.

Salida, and Denver. 4500 w. Min & Sci Pr—Jan. 1, 1910. No. 10661.

See also Electric Driving, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Reviews of 1909.

Lead and Spelter Industry of the United States. Review of the production during the past year, with information concerning consumption, prices, etc. 1200 w. Min Wld—Jan. 22 1910. No. 10980.

The Production of Lead and Spelter in 1909. A review of mining conditions, giving statistics of production and price. 9000 w. Eng & Min Jour—Jan. 8, 1910. No. 10730.

Zinc Smelting.

Electric Zinc Smelting by the Côte and Pierron Process (L'Electrométallurgie du Zinc par le Procédé E. F. Côte et P. Pierron). An extended abstract of a paper by M. Côte fully describing the process. Ills. Serial. 1st part. 4500 w. L'Elecn —Dec. 18, 1909. No. 11029 D.

Zinc Sulphate.

The Manufacture of Zinc Sulphate and its Utilization in Painting Materials (La Fabrication du Sulfure de Zinc et son Utilisation dans les Travaux de Peinture). MM. Pipereaut and Vila. A discussion, based on tests, of the use of zinc oxide and zinc sulphate to replace white lead. 16000 w. Bul Soc d'Encour—Nov., 1909. No. 11012 G.

MINOR MINERALS.

Asbestos.

Progress of the Asbestos Industry of Quebec. Alexander Gray. A report of the industry, the production, exports and imports, etc. 2000 w. Min Wld—Jan. 22, 1910. No. 10983.

Building Stone.

See Clays, under MINOR MINERALS.

Cement.

New Cement Mill Near Montreal. Illustrated detailed description of the plant of the Vulcan Portland Cement Co. 3500 w. Engr, Lond—Dec. 31, 1909. No. 10757 A.

Clays.

Clays and Building Stones of the South. Ernest F. Burchard. An outline of the clay resources, granite, marble, limestone, sandstone, etc. 4500 w. Mfrs' Rec—Jan. 6, 1910. (Special No.) No. 10678 C.

Graphite.

Graphite Mining in Ceylon. Illustrates and describes the deposits and methods of mining and preparing for market. 1500 w. Sci Am—Jan. 8, 1910. No. 10670.

Natural Gas.

See Reviews of 1909, under COAL AND COKE.

Nickel.

A Record Year in the Canadian Nickel Fields. Alexander Gray. Information and discussion of the nickel industry, particularly during the past year. 3000 w. Min Wld—Jan. 22, 1910. No. 10982.

Nitrates.

Nitrate of Soda Industry of Chile. S. H. Loram. Information concerning the deposits, theories of their origin, etc. 3500 w. Min & Sci Pr—Jan. 15, 1910. Serial. 1st part. No. 10931.

Oil.

Oil Field Phenomena. A. Beeby Thompson. A brief review of the mode of occurrence of petroleum and the means used in its search and recovery. Ills. 3500 w. Yale Sci M—Jan., 1910. No. 11150 C.

The Petroleum Industry of the United States. Reviews the production of the various districts, prices and other matters of interest. 6500 w. Eng & Min Jour—Jan 8, 1910. No. 10735.

Petroleum in Illinois in 1909. Raymond S. Blatchley. A review of operations, production, etc. 800 w. Min & Sci Pr—Jan. 8, 1910. No. 10865.

Mid-Continent Oil and Gas Fields. L. L. Hutchison. Reviews the fields of Missouri, Kansas, Oklahoma, Indian Territory and Texas. 1500 w. Min & Sci Pr—Jan. 8, 1910. No. 10864.

Oil Industry in California in 1909. A review of the various oil producing districts. 2000 w. Min & Sci Pr—Jan. 8, 1910. No. 10863.

The Petroleum Industry in Roumania (l'Industrie du Pétrole en Roumanie). M. Philipescu. The first part of the serial deals with the geological features of the oil fields. Ills. Serial. 1st part. 4500 w. Bul Sci d l'Assn des Elèves—Dec., 1909. No. 11000 D.

Phosphate.

See Tunis, under MISCELLANY.

Platinum.

See Production, under GOLD AND SILVER.

Quicksilver.

Quicksilver in the United States in 1909. H. W. Turner. Brief review of production and prices. 1000 w. Eng & Min Jour—Jan. 8, 1910. No. 10732.

Quicksilver in California. A report of the present condition of the quicksilver mining industry. 1700 w. Min & Sci Pr—Jan. 1, 1910. No. 10657.

Sulphate of Ammonia.

Sulphate of Ammonia in 1909. Discusses the supply and demand in the United Kingdom. 2500 w. Ir & Coal Trds Rev—Jan. 14, 1910. No. 11134 A.

Tin.

Tin in 1909. Brief review of the production and market. 1000 w. Eng & Min Jour—Jan. 8, 1910. No. 10736.

MINING.

Blasting.

Firing Shots in Mines by Electricity. Sydney F. Walker. Discusses the causes of misfires and gives suggestions regard-

ing the selection of high and low tension fuses. 2000 w. Eng & Min Jour—Jan. 22, 1910. No. 10988.

Drills.

A New Hydraulic Rock-Boring Drill. Illustrates and describes the invention of Waelaw Wolski, an Austrian engineer. 1500 w. Engr, Lond—Jan. 7, 1910. No. 10919 A.

Compressed Air Percussion Drills (La Perforation mécanique par Percussion à l'Air conprimé). Henri Petit Bois. A brief theoretical discussion of air hammer drills. Ills. 2500 w. Bul Sci d l'Assn des Elèves—Dec., 1909. No. 11001 D.

Electric Power.

Electrical Applications in Mining Work, with Special Reference to Mining Methods in Mexico. C. V. Allen. Illustrates and describes its use in ventilation, pumping, ore handling, crushing, etc. 5500 w. Elec Jour—Jan., 1910. No. 11159.

Engineering Ethics.

Professional Ethics. R. W. Raymond. Considers the subject under the heads of authors, employes, agents or private or public advisers. 8000 w. Bul Am Inst of Min Engrs—Jan., 1910. No. 11257 F.

Explosives.

Safe Ways of Thawing Dynamite. Matt. W. Alderson. Describes a safe and inexpensive thawer. 1500 w. Min Wld—Jan. 1, 1910. No. 10534.

High Explosives. W. R. Quinan. Summary of a paper by Dr. Arthur M. Corney, entitled "Study of the Velocity of Detonation." A detailed account of experimental investigations of a variety of explosives. 2200 w. Aust Min Stand—Dec. 22, 1909. Serial. 1st part. No. 11299 B.

See also same title, under RAILWAY ENGINEERING, TRAFFIC.

Haulage.

Electric Haulage at the Loftus Ironstone Mines. Illustrated description of an installation recently placed in service. 3000 w. Engr, Lond—Jan. 7, 1910. No. 10917 A.

An Electrically Operated Plane. Dr. Alfred Gradenwitz. Illustrated description of a plane at Donawitz, Austria, showing the arrangement of tracks, and the electric hoisting and braking apparatus. 2000 w. Mines & Min—Jan., 1910. No. 10570 C.

See also Hoisting, under MINING.

Hoisting.

Skip-Changing Devises at Butte. R. L. Herrick. Illustrates and describes the installations at the Diamond, the new Leonard, and the St. Lawrence shafts as indicating the types used. 2000 w. Mines & Min—Jan., 1910. No. 10572 C.

Locomotives vs. Stationary Hoisting Engines for Raising Material in Open Cut Mines. J. F. Jackson. Discusses the economical limits of grades for economical hoisting by means of locomotives and the writer's solution of the problem. 1200 w. Eng News—Jan. 13, 1910. No. 10816.

A Graphical Method of Determining the Thickness and Weight per Metre of Vertongen Rope at Any Point Along Its Length (Détermination graphique de l'épaisseur et du Poids par Mètre courant du Câble Vertongen en ses différents Points). Gaston Deladrière. Mathematical discussion of hoisting cables of uniform strength. Ills. 1800 w. Bul Sci d l'Assn des Elèves—Dec., 1909. No. 11002 D.

Methods.

Modern Progress in Mining and Metallurgy in the Western United States. Discussion of the paper of D. W. Brunton, presented at the Spokane meeting. 8000 w. Bul Am Inst of Min Engrs. Jan., 1910. No. 11259 F.

Mine Models.

Glass Mine-Models. Edmund D. North. illustrations and details of a model of the Montana-Tonopah mine-workings, describing method. 1000 w. Bul Am Inst of Min Engrs—Jan., 1910. No. 11253 F.

Mine Signals.

A New Shaft Signal Apparatus (Ein neuer Schachtsignalapparat). Hans Mentzel. Illustrated description of an elaborate electrical device. Ills. 2500 w. Glückauf—Dec. 18, 1909. No. 11066 D.

Mining Investments.

Suggestions Regarding Mining Investments. John Hays Hammond. Address before the Finance Forum of New York. Explains difference between prospects and mines, and gives some "don'ts" for investors. 4500 w. Eng & Min Jour—Jan. 1, 1910. No. 10535.

The Safety of Judicious Mining Investments. J. Parke Channing. Discusses returns on mining investments, valuation, what company reports should contain, etc. 4000 w. Eng & Min Jour—Jan. 22, 1910. No. 10984.

Prospecting.

See Boring, under CIVIL ENGINEERING, CONSTRUCTION.

Sampling.

A Case of Mine Sampling. L. M. W. Judell. A comparison of the face, grab and bulk systems of sampling carried out in the same workings. 1500 w. Aust Min Stand—Nov. 24, 1909. No. 10626 B.

Shafts.

Circular vs. Rectangular Shaft Sinking. Henry M. Payne. Claims that the cost of lining circular shafts is less and that they are safer and more permanent. 1500 w. Eng & Min Jour—Jan. 22, 1910. No. 10989.

The Construction of Cage Guides in Coal Pits. Abstract of report of committee appointed by the Royal Commission on Mines. Discusses rigid guides

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and flexible guides. Ills. 2000 w. Mech Engr—Jan. 7, 1910. No. 10906 A.

See also Timbering, under MINING.

Stowing.

The Sandfilling Process, or Waterborne Packing of Stopes. Karl Leinberger. Translation of an article by Pütz. Plates, description and discussion. 7000 w. Jour S African Assn of Engrs —Nov., 1909. No. 10926 F.

Recent Practice in Flushing (Ueber die Erfahrungen beim Spülversatz in neuerer Zeit). Herr Busch. A review of methods, costs, pipe-line materials and construction, etc. Ills. 3500 w. Stahl u Eisen—Dec. 15, 1909. No. 11054 D.

Timbering.

The Use of Concrete in Mines. Extracts from a paper by W. R. Crane, with illustrations, dealing with the application of reinforced-concrete in mining drawn principally from American practice. 4500 w. Cement Age—Jan., 1910. No. 11196.

Unwatering.

The Pumping Problems at the Tombstone Mine. W. F. Staunton. Brief account of the flooding to 800 ft. level, and the new equipment ordered to effect the unwatering. 1200 w. Eng & Min Jour—Jan. 15, 1910. No. 10867.

ORE DRESSING AND CONCENTRATION.

Concentrators.

Mexican "Plantilla" Concentrator. Illustrated description of an effective concentrating apparatus that can be built of native materials. 2000 w. Mines & Min —Jan., 1910. No. 10576 C.

Copper.

The Concentrator of the Ohio Copper Co. Leroy A. Palmer. Illustrated description of the concentrator at Lark, Utah. 3500 w. Min Wld—Jan. 8, 1910. No. 10718.

See also British Columbia, under COPPER.

Crushing.

Coarse Crushing at the Boston Consolidated Mill at Garfield, Utah. L. S. Austin. Illustrated description showing the good points of the plant. 800 w. Min & Sci Pr—Jan. 15, 1910. No. 10930.

Drying.

Calculations for Dryer Design. Dr. William M. Grosvenor. Abstract of paper presented to the Am. Inst. of Chem. Engrs. Explanation of methods developed. 2 charts. 4500 w. Met & Chem Engng—Jan., 1910. No. 10831 C.

Electrostatic Separation.

Elcetrostatic Zinc Separation. Leroy A. Palmer. Illustrates and describes the Huff separators at the Platteville and the Midvale plants of the American Zinc, Lead, and Smelting Co. 6000 w. Mines & Min —Jan., 1910. No. 10573 C.

Filtration.

Slime Filtration. Illustrates and describes a new Sweetland filter press designed to have the chief advantages of vacuum filters. 1800 w. Met & Chem Engng—Jan., 1910. No. 10833 C.

Pressure Filtration. Ernest J. Sweetland. A record of experimental results of tests made to obtain information for application in everyday practice. 1700 w. Min & Sci Pr—Dec. 25, 1909. No. 10530.

Gold Milling.

Milling Practice on the California Mother Lode. William H. Storms. Describes the long established methods of milling gold ores. 3500 w. Min Wld—Jan. 1, 1910. No. 10531.

See also Rand, under GOLD AND SILVER.

Iron.

Concentrating the Lean Ores of the Mesaba Range. Dwight E. Woodbridge. Illustrated description of the plant of the Oliver Iron Mining Co. at Coleraine, Minn., and the developments at the Canisteo and other mines. 2500 w. Ir Age—Jan. 6, 1910. No. 10617.

Lead Milling.

New Concentrator of the Bunker Hill & Sullivan. Gelasio Caetani. Illustrated detailed description of the plant. 1500 w. Min & Sci Pr—Jan. 15, 1910. No. 10929.

Ore Dressing.

Progress and Problems in Ore Dressing. Courtenay DeKalb. Summarizes the advances made in ore dressing, the developments in concentrators and the tendencies in America. 3500 w. Min & Sci Pr—Jan. 1, 1910. No. 10665.

Slimes Treatment.

Cyaniding Slime. Mark R. Lamb. Describes the series method of treating pulp and its advantages. 1500 w. Bul Am Inst of Min Engrs—Jan., 1910. No. 11256 F.

Treatment of Ore Slime. Andrew F. Crosse. Describes the writer's slime process. 1600 w. Jour Chem, Met, & Min Soc of S Africa—Nov., 1909. No. 10925 E.

Stamp Mills.

The Development of Heavy Gravitation Stamps. W. A. Caldecott. A report of milling tests carried out to discover some means for increasing stamp-milling efficiency. Ills. 2000 w. Aust Min Stand—Dec. 8, 1909. Serial. 1st part. No. 10888 B.

MISCELLANY.

Alaska.

Mining in Alaska in 1909. A statement of the mineral production with map. 3000 w. Min & Sci Pr—Jan. 1, 1910. No. 10659.

Algeria.

See Tunis, under MISCELLANY.

Australia.

The Condition of Mining in Queensland. Information concerning production, methods, deposits, etc. 2500 w. Aust Min Stand—Dec. 1, 1909. No. 10886 B.

British Columbia.

Review of Mining in the Province of

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British Columbia in 1908. George A. Ohren. 2500 w. Can Min Jour—Jan. 1, 1910. No. 10557.

Mining in British Columbia in 1909. E. Jacobs. A review of the year's work and progress. 5000 w. Can Min Jour—Jan. 15, 1910. No. 10936.

Mexico.

Geological Notes on West Coast of Mexico. C. W. Botsford. General notes and classification of the ore deposits. 2500 w. Eng & Min Jour—Jan. 22, 1910. No. 10987.

Ontario.

The Year in Ontario. Thomas W. Gibson. A review of the progress of the mineral industry during 1909. Map. 2500 w. Can Min Jour—Jan. 15, 1910. No. 10937.

Ore Deposits.

Some Regionally Metamorphosed Ore Deposits and the So-Called Segregated Views. William H. Emmons. Gives results of a recent study of metamorphosed ore deposits in Maine and New Hampshire and refers to other deposits in the eastern states and provinces. Ills. 9500 w. Ec-Geol—Dec., 1909. No. 11178 D.

Quebec.

The Year in the Province of Quebec. H. Mortimer Lamb. Map and review of the mining industry for 1909. 2000 w. Can Min Jour—Jan. 15, 1910. No. 10935.

Reviews of 1909.

Our Mineral Statistics. Review of the general report and statistics for 1909 on the output of British mines and quarries. 3500 w. Engr, Lond—Dec. 31, 1909. No. 10755 A.

Mining in the United States During 1909. A review by states, of the development, output, prices, and other matters of related interest. Maps. 28500 w. Eng & Min Jour—Jan. 8, 1910. No. 10733.

Review of Mining in Foreign Countries. Reviews the past year's developments in South Africa, Australasia, Mexico, Canada, Central America, Peru, Chile and other countries. 25000 w. Eng & Min Jour—Jan. 8, 1910. No. 10734.

Tasmania.

Development of Mining in Tasmania. Discusses the income tax, complex ores bill, and matters of interest to the mining industry. 2000 w. Aust Min Stand—Dec. 1, 1909. No. 10887 B.

Tunis.

Metal and Phosphate Mining in Tunis and Algeria (Bemerkungen über einige Erz- und Phosphatbergbaue im Zentralen Tunis und im Küstengebiet Algeriens). B. Granigg. A general review. Ills. Serial. 1st part. 4000 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 4, 1909. No. 11059 D.

United States.

The Development of Southern Mineral Industries. Dr. David T. Day. Brief explanation of the trade methods at the present time, showing how many industries in the South can flourish because of the distance of the raw material from competitive centers. 5000 w. Mfrs' Rec—Jan. 6, 1910. (Special No.) No. 10675 C.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Signaling.

Studies in Circuits as Applied to Signaling. James H. Cormick. A series of lessons on the circuits used in railway signaling. Ills. 1500 w. Sig Engr—Jan., 1910. Serial. 1st part. No. 10998.

Second Annual Report of the Block Signal and Train Control Board to the Interstate Commerce Commission. Ills. 32000 w. Int Com Com—Nov. 22, 1909. No. 11251 N.

Second Annual Report of the Block Signal and Train Control Board to the Interstate Commerce Commission. Editorial review. 3000 w. R R Age Gaz—Dec. 31, 1909. No. 10556.

Mileage of Railways Block Signaled. Notes of the proposed new installations, with explanations of some of the changes of last year. 3000 w. R R Age Gaz—Dec. 31, 1909. No. 10554.

See also Subway Signaling, under STREET AND ELECTRIC RAILWAYS.

Signal Lanterns.

Railway Signal Lanterns and Long-Time Burners. C. O. Harrington. A discussion of burners, flames, chimneys, wicks, drafts, sweating, oil consumption, and proper care of lanterns. Diagrams. 3500 w. Sig Engr—Jan., 1910. No. 10996.

Train Speeds.

British and French Railway Speed in 1909. A review of the train services. 1000 w. Engr, Lond—Dec. 31, 1909. No. 10756 A.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Care of H 6 Equipment. Suggestions concerning the maintenance of air brakes of this type. Ills. 2500 w. Ry & Loc Engng—Jan., 1910. No. 10559 C.

Car Bearings.

The Side and Centre Bearings of a Car. A. Stucki. Discusses the advantages and construction of anti-friction side bearings. Also general discussion. Ills. 17500 w. Pro Ry Club of Pittsburgh—Nov. 26, 1909. No. 11145 C.

We supply copies of these articles. See page 970.

Draft Gears.

An Experimental Study of the Resistance to Traction of Draft Gears (Etude expérimentale de la Résistance vive à la Traction des Attelages de Wagons). Ch. Frémont. A discussion of the shocks to which draft gears are subjected, with a suggestion for improving their construction. Ills. 3000 w. Bul Soc d'Encour—Nov., 1909. No. 11013 G.

Electrification.

Financial Aspect of the Application of Electric Motive Power to Railroads. F. Darlington. Discusses the relative economy in both local and long-distance traction. 5000 w. Engineering Magazine—Feb., 1910. No. 11267 B.

Freight Cars.

Coal Cars and Coal Trains of the Virginian Ry. Plans and description of special cars and locomotives designed to meet stated requirements. 2000 w. Eng News—Jan. 13, 1910. No. 10813.

Locomotive Boilers.

Method of Applying and Maintaining Tubes in Locomotive Boilers—Pennsylvania Railroad Standards. Information concerning the standard tube practice adopted which has greatly reduced leaky tubes. Ills. 700 w. Ry Age Gaz—Jan. 7, 1910. No. 10701.

Narrow-Gauge Locomotive Boilers (Note sur la Tenue des Chaudières de Locomotive á Voie étroite). M. Fermé. A discussion of recent developments to meet the demands of modern traffic. Ills. 4500 w. Rev de Mécan—Dec., 1909. No. 11225 E + F.

Locomotive Fuels.

The Ton-Mile-Per-Hour. George S. Hodgins. Explains the advantage of using this system of coal accounting. 1500 w. Ry & Loc Engng—Jan., 1910. No. 10562 C.

Fuel Economy on Testing Plants and Railroads. H. H. Vaughan. Read before the W. Can. Ry. Club. Defines an ideal steam engine, examining the standard to which the locomotive has approximated, its efficiency on the testing plant and in service. 4000 w. Am Engr & R R Jour—Jan., 1910. No. 10763 C.

Locomotives.

Simple 4-6-2 for the Michigan Central Railroad. Illustrated description of heavy Pacific type locomotives recently completed. 900 w. Ry & Loc Engng—Jan., 1910. No. 10561 C.

New Passenger Engines for the Chicago & Northwestern Ry. Illustrated description of a Pacific type passenger locomotive. 700 w. Ry & Engng Rev—Jan. 22, 1910. No. 10561 C.

Articulated Oil Burning Locomotives with Cab Ahead. Brief illustrated description of new engines for the Southern Pacific. 400 w. Am Engr & R R Jour—Jan., 1910. No. 10764 C.

Locomotive for the L., T., and S. Railway. Plate and description of the more important details. 500 w. Engng—Dec. 31, 1909. No. 10751 A.

Three-Cylinder Shunting Locomotive; North-Eastern Railway. Illustrated description of a powerful shunting-engine built for use in marshalling yards. 800 w. Engng—Jan. 14, 1910. No. 11126 A.

New French Locomotives. Illustrations and brief description of a goods engine for the Paris, Lyons, and Mediterranean Company. 400 w. Engr, Lond—Dec. 24, 1909. No. 10647 A.

Express Passenger Locomotives; Paris, Lyons, and Mediterranean Railway. Ernest Graham. Illustrates and describes recent types of engines compounded on the Henri-Baudry system. 1800 w. Ry Age Gaz—Jan. 7, 1910. No. 10702.

Recent Foreign Locomotives (Recents Costruzioni di Locomotive all'Estero). I. Valenziani. Describes recent developments outside Italy. Ills. Serial. 1st part. 1600 w. Ing Ferro—Dec. 1, 1909. No. 11045 D.

The 5/5 Coupled Compound Freight Locomotive of the Servian State Railways (Die 5/5-gekuppelte Güterzug-Verbundlokomotive der Serbischen Staatseisenbahnen). A Buchterkirchen. Illustrates and describes a locomotive built by A. Borsig. 4200 w. Zeitschr der Ver Deutscher Ing—Dec. 4, 1909. No. 11215 D.

The 2C1 Four-Cylinder Compound Superheater Locomotives of the Wurtemberg State Railways (Die 2C1-Vierzylinderverbund-Heissdampflokomotiven der Württembergischen Staatseisenbahnen). Herr Dauner. Illustrated description. 4500 w. Zeitschr d Ver Deutscher Ing—Dec. 18, 1909. No. 11219 D.

Locomotive Superheaters.

A New Steam Superheater for Locomotives; Atchison, Topeka & Santa Fe Ry. Illustrated detailed description of the Jacobs superheater and applications to locomotives. 1800 w. Eng News—Jan, 27, 1910. No. 11281.

Locomotive Tenders.

Tender of 12000 Gallons Capacity for Mallet Locomotives, Atchison, Topeka & Santa Fe. Illustrates and describes details of construction and design. 2000 w. Ry Age Gaz—Jan. 21, 1910. No. 10950.

Locomotive Tests.

Comparative Tests of Consolidation and Mallet Locomotives on Southern Pacific. An account of these tests with tabulated results 1000 w. Ry Age Gaz—Jan. 14, 1910. No. 10881.

Locomotive Works.

History of the Baldwin Locomotive Works. An account of the men who created and managed the works for 78 years. Ills. 1500 w. Ry Age Gaz—Jan. 21, 1910. No. 10952.

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Motor Cars.

A Large Gasoline Motor Car for the Oregon Short Line Ry. Plan, elevation and description of one of the latest cars of the McKeen type. 1200 w. Eng News—Jan. 20, 1910. No. 10964.

Refrigeration.

Precooling plant at Roseville, California. Illustrated description of the new plant of the Pacific Fruit Express, using the intermittent vacuum system of precooling cars. 3000 w. Ice & Refrig—Jan., 1910. No. 10710 C.

Shops.

General Shops of the Sud-Pacifico de Mexico at Empalme. Illustrated detailed description of shops for locomotive, passenger and freight car repairing and rebuilding. 1200 w. Ry Age Gaz—Jan. 7, 1910. No. 10700.

Locomotive and Car Repair Shops of the New Orleans Great Northern at Bogalusa, La. Illustrates and describes a good example of modern design and construction adapted to a small road and serving as a locomotive terminal as well as a repair plant. 2000 w. Ry Age Gaz—Jan. 7, 1910. No. 10706.

Some American Shops for the Repair and Construction of Locomotives (Note sur quelques Ateliers de Réparation et de Construction de Locomotives en Amérique). J. Desgeans and F. Houlet. Impressions of American locomotive-shop practice gained from a visit to eight of the largest establishments in the United States and Canada. Ills. 8000 w. Rev Gen d Chemins de Fer—Dec., 1909. No. 11015 G.

See also Foundries, and Shop Practice, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Train Ferries.

See Ferryboats, under MARINE AND NAVAL ENGINEERING.

Train Lighting.

Electric Train Lighting (Ueber elektrische Zugbeleuchtung). Max Jacob. A criticism of Max Büttner's recent paper. 2000 w. Elek Kraft u Bahnen—Dec. 14, 1909. No. 11206 D.

PERMANENT WAY AND BUILDINGS.

Construction.

The Copper River & Northwestern Railway. Illustrates and describes physical features of this railway, built under difficult conditions, to develop some of the natural resources of Alaska. 2500 w. Eng Rec—Jan. 22, 1910. No. 10969.

Engineering Construction on the Southern Railway. First of a series of articles illustrating and describing extensive work in connection with grade and alignment revisions. 1200 w. Ry & Engng Rev—Jan. 8, 1910. Serial. 1st part. No. 10709.

A Railway Ditching Machine for Small Cuts and Fills. Illustrated detailed description of a machine used on the Southern Pacific Ry. 1800 w. Eng News—Jan. 20, 1910. No. 10960.

Culverts.

See same title, under CIVIL ENGINEERING, BRIDGES.

Curves.

Friction at Railway Curves. J. F. Springer. Explains the action of wheels on curves and the causes of excessive wear, discussing methods proposed to remedy the trouble. Ills. 1600 w. Sci Am—Jan. 8, 1910. No. 10669.

Elevated Railways.

Evanston Track Elevation, Chicago, Milwaukee & St. Paul Ry. E. O. Greifenhagen. The first of three articles on the grade crossing improvements. Ills. 3000 w. Eng Rec—Jan. 22, 1910. Serial. 1st part. No. 10974.

Switches.

Automatic Point Operating Gear for Railways and Tramways (Manovrascambi automatico per Ferrovie e Tramvie). B. Benigni. Detailed description. Ills. 2500 w. Ann d Soc d Ing e d Arch Ital—Dec. 15, 1909. No. 11036 F.

Terminals.

Locomotive Terminals. A discussion of the arrangement, design, construction and operation of locomotive terminal facilities to obtain the greatest efficiency. Ills. 7500 w. Am Engr & R R Jour—Jan., 1910. Serial. 1st part. No. 10762 C.

Yards.

Yard Damage Preventives. Charles Burlingame. Read before the Cent. Assn. of R. R. Officers. Suggests remedies that have given good results. 7000 w. Ry & Engng Rev—Jan. 22, 1910. No. 10991.

TRAFFIC.

Explosives.

The Testing of Explosives with Regard to Their Admission for Transportation. Dr. F. Lenze. Trans. from *Zeit. für das gesamte Schiess- und Sprengstoffwesen.* Describes investigations in Germany to determine the safety of explosives during railway transportation. 2000 w. Jour Fr Inst—Jan., 1910. No. 11241 D.

The Testing of Explosives with Regard to Their Admission for Transportation. Dr. W. Will. Trans from *Zeit. für das gesamte Schiess- und Sprengstoffwesen.* Gives results of an investigation in Germany. 1000 w. Jour Fr Inst—Jan., 1910. No. 11240 D.

K. C., M., & O.

Traffic Report on the Kansas City, Mexico & Orient. Map and review of a report on the probable future earnings and traffic possibilities of the property. 1800 w. Ry Age Gaz—Jan. 21, 1910. No. 10951.

Perishable Freight.

On the Question of Perishable Goods

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(Subject XVI. for Discussion at the Eighth Session of the Railway Congress). J. M. Culp. Discusses suitable measures for developing traffic in perishables. 28900 w. Bul Int Ry Cong—Dec., 1909. No. 11263 G.

MISCELLANY.

Belgium.

Transportation and Traffic in Belgium. Logan G. McPherson. Describes the conditions and requirements, the waterways and railways, discussing traffic statistics, rates, etc. 3500 w. Ry Age Gaz—Jan. 28, 1910. No. 11305.

Canada.

The Railway Situation in Canada. J. L. Payne. A detailed account of the development and present situation, showing progress, strength and a promising outlook. 3000 w. Ry Age Gaz—Jan. 14, 1910. No. 10883.

China.

Internal Communication in China. Editorial on the remarkable change in the attitude of China toward modern progress, and discussing the need of internal communication and the new regular service on the Upper Yangtse Kiang. 1800 w. Engng—Jan. 14, 1910. No. 11125 A.

Finance.

Dividend Changes and New Railway Securities in 1909. Gives tables showing the changes and new securities which reflect the improved earnings, with comments. 3000 w. R R Age Gaz—Dec. 29, 1909. No. 10553.

Germany.

Transportation and Traffic in Germany. Logan C. McPherson. The present number is mainly a historical review of the development. 3000 w. Ry Age Gaz—Jan. 14, 1910. Serial. 1st part. No. 10882.

Java.

Steam Tramways in Java (Die Dampftrambahnen auf Java). A brief general review of railway development in Java. 2300 w. Glasers Ann—Dec. 15, 1909. No. 11088 D.

Mexico.

Government Railway Control in Mexico. E. H. Talbot. Explanation of the purpose of the Mexican Government in adopting the policy of national control of its railway system, and information related. Map. 2000 w. Ry Age Gaz—Jan. 28, 1910. No. 11306.

Narrow-Gauge.

The Difficulties of Effecting Junctions and Exchanging Rolling Stock on Metre-Gauge Railways (Note sur les Difficultés de Raccordement et d'Echange du Matériel entre les Chemins de Fer à Voie de 1 Mètre). M. Pellarin. A consideration of European railways of local interest. Ills. 8800 w. Ann d Ponts et Chaussées—1909-VI. No. 11078 E + F.

Norway.

The Bergen and Christiana Railway. An illustrated description of this new railway through the most mountainous region in Norway, where great natural difficulties had to be overcome. Map. 5000 w. Engng—Dec. 24, 1909. No. 10640 A.

Railway Securities.

Regulation of the Issuance and Ownership of Railway Securities. Editorial discussion of the part of Pres. Taft's recent message regarding regulation of railways and trusts. 2000 w. Ry Age Gaz—Jan. 21, 1910. No. 10949.

Reviews of 1909.

Railways and Tramways. Begins a review of progress during 1909. The present number briefly considers the United Kingdom, Continental Europe, and Greater Britain. Ills. 4000 w. Engr, Lond—Jan. 7, 1910. Serial. 1st part. No. 10918 A.

Review of 1909 Annual Reports. Ray Morris. Shows the prevailing tendencies of the railway year by means of graphic analysis. 1500 w. R R Age Gaz—Dec. 31, 1909. No. 10552.

Review of 1909. Editorial on the progress of American railways during the year. 2500 w. R R Age Gaz—Dec. 31, 1909. No. 10551.

Simplon.

The Franco-Swiss Convention on the Lines of Access to the Simplon Tunnel (La Convention Franco-Suisse sur les Voies d'Accès au Simplon). A Lebrun. A discussion of the Alpine railway situation. Ills. 2600 w. Génie Civil—Dec. 11, 1909. No. 11032 D.

South America.

Buenos Ayres & Pacific. Map and brief description of lines between Buenos Ayres and Mendosa. 800 w. Ry Age Gaz—Jan. 28, 1910. No. 11301.

Statistics.

On the Question of Statistics (Subject XIV for Discussion at the Eighth Session of the Railway Congress). Thomas R. Price. Considers principles of statistics of railways in operation. 18400 w. Bul Int Ry Cong—Dec., 1909. No. 11262 G.

United States.

Railroad Work South and Southwest. Samuel G. Wilmer. Reviews what has been accomplished in the recent past, and the future prospects. 2500 w. Mfrs' Rec—Jan. 6, 1910. (Special No.) No. 10679 C.

Valuation.

Original Cost and Cost of Reproduction of the Northern Pacific Railway (1645 miles) in the State of Washington. Data as determined by Halbert P. Gillette, and given as testimony at the hearings before the Railroad Commission. 3500 w. Engng-Con—Jan. 12, 1910. No. 10824.

We supply copies of these articles. See page 970.

STREET AND ELECTRIC RAILWAYS.

Car Barns.

New Car House of the Capital Traction Company, Washington, D. C. Illustrated detailed description. 1500 w. Elec Ry Jour—Jan. 8, 1910. No. 10654.

Cars.

Large Cars Built by the Key Route, Oakland, Cal. Illustrated description of cars having an extreme length of 70 ft. over couplers. 1000 w. Elec Ry Jour—Jan. 15, 1910. No. 10858.

Controllers.

Point Controllers for Electric Tramways. J. P. Tierney. Abstract of a paper read before the Inst. of Elec. Engrs. Reviews the development and describes the latest form of the Tierney-Malone point controller. Ills. 4500 w. Elec Engr, Lond—Dec. 31, 1909. No. 10778 A.

An Improved Type of Point Controller for Electric Tramways. J. P. Tierney. Describes the early forms and the present design of the "Tierney-Malone" point controller. Ills. 2500 w. Elect'n, Lond—Dec. 24, 1909. No. 10635 A.

Direct Current.

A 2750-Volt Direct Current System. A. H. Barringer. Read before the Can. Soc. of Civ. Engrs. Describes a system installed at Twickenham, near London, reporting concerning the difficulties encountered in operation. 2500 w. Elec Engr, Lond—Dec. 31, 1909. No. 10779 A.

Economics.

The Proper Treatment of Electric Railway Properties. J. McMillan. Gives details of costs and rates. 2500 w. Elec Ry Jour—Jan. 1, 1910. No. 10527.

Electric Traction.

The Equipment and Working Results of the Mersey Railway under Steam and under Electric Traction. Joshua Shaw. 6000 w. Elec Age—Jan., 1910. No. 11308.

Elevated Railways.

Forest Hills Terminal of the Boston Elevated Railway. John Ware. Illustrates and describes the concrete construction. 2200 w. Harvard Engng Jour—Jan., 1910. No. 11149 D.

Great Northern.

See Three Phase, under STREET AND ELECTRIC RAILWAYS.

Interurban.

Important New Work of the Illinois Traction System. Illustrates and describes the construction of McKinley bridge, a terminal in St. Louis, re-equipment of 100 miles of single-phase railroad for operation with d. c., new cars, repair shop extension, etc. 5000 w. Elec Ry Jour—Jan. 22, 1910. No. 10927.

Monorail.

The Scherl Gyroscopic Monorail Car. Illustrates and describes the principle of its operation. 1500 w. Sci Am—Jan. 22, 1910. No. 10958.

Operation.

The Methods Employed for Working Electric Railways. E. C. Zehme. Abstract from a book edited by Ludwig von Stockert. Ills. 11500 w. Bul Int Ry Cong—Dec., 1909. No. 11265 G.

Power Stations.

See Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Rails.

The Design of Tramway Rails, and Rail Wear. Robert B. Holt. Aims to show that the present design of tramway rails is at fault, and responsible for much of the unnecessary wear. Ills. 2000 w. Tram & Ry Wld—Jan. 6, 1910. No. 10923 B.

Reviews of 1909.

See same title, under RAILWAY ENGINEERING, MISCELLANY.

Subways.

See Tunnels, under CIVIL ENGINEERING, CONSTRUCTION.

Subway Signaling.

Signal System of the Hudson & Manhattan R. R. John Leisenring. Illustrated description of the signaling in the down town tunnels of the H. & M. R. R. (2d part.) 4500 w. Sig Engr—Jan., 1910. No. 10997.

Subway Terminals.

A Terminal Station. J. Vipond Davies and J. Hollis Wells. Read before the A. I. A., at Washington, D. C. A statement of conditions at New York City, the causes that led to the construction of tunnels under the rivers, and the selection of location and construction of the Hudson terminal buildings. Ills. 8500 w. Am Archt—Jan. 19, 1910. No. 10934 C.

Three Phase.

Discussion on "The Electric System of the Great Northern Railway Company at Cascade Tunnel." New York, Nov. 12, 1909. Also at Minnesota section, Nov. 18, 1909. 14000 w. Pro Am Inst of Elec Engrs—Jan., 1910. No. 11250 F.

Valuation.

Official Valuations of Private Property. Frederick W. Whitridge. Abstract of an address before the Am. Economic Assn., N. Y. Discusses methods of valuation. 3000 w. Elec Ry Jour—Jan. 15, 1910. No. 10859.

We supply copies of these articles. See page 970.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Applied Science. *m.* Toronto, Ont.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin du Lab. d'Essais. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Clay Record. *s-m.* Chicago.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.

Consular Reports. *m.* Washington.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giesserei-Zeitung. *s-m.* Berlin.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial Engineering. *m.* Pittsburg.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. Ind. & Engng. Chem. *m.* Easton, Pa.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *w.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *w.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista Tech. Ind. *m.* Barcelona.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland. Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Ein neues Schnellbahn-System. By August Scherl. Size, 11 by 14 in.; pp., 122. Ills. Berlin: August Scherl.

Who's Who in Mining and Metallurgy, 1908. Size, 8 by 5½ in.; pp., 194. Ills. London: The Mining Journal.

Audel's Gas Engine Manual. Size, 8½ by 5½ in.; pp., xxiv, 469. Ills. Price, $2. New York: Theo. Audel & Co.

Soudure Autogène et Aluminothermie. By E. Chatelain. Size, 7 by 4½ in.; pp., x, 177. Ills. Price, 3 fr. 50 c. Paris: Gauthier-Villars.

Asphalts, their Sources and Utilization. By T. Hugh Boorman. Size, 9½ by 6½ in.; pp., 168. Ills. Price, $3. New York: William T. Comstock.

Notes on Hydro-Electric Developments. By Preston Player. Size, 7½ by 5 in.; pp., 68. Ills. Price, $1. New York: McGraw Publishing Company.

The Refrigeration Engineer's Pocket Manual. By Oswald Gueth. Size, 7½ by 4½ in.; pp., 156. Ills. New York: Published by the Author.

Laboratory Experiments in Metallurgy. By Albert Sauveur and H. M. Boylston. Size, 10 by 8 in.; pp., 73. Ills. Cambridge, Mass.: Published by the Authors.

The Essentials of Lettering. By Thomas E. French and Robert Meiklejohn. Size, 6½ by 9 in.; pp., 72. Ills. Price $1. Columbus, O.: Varsity Supply Company.

Die Entwicklung der deutschen Eisenindustrie in den letzten Jahren. By F. Wüst. Size, 11 by 7½ in.; pp., 33. Ills. Price, M. 1.50. Halle a. S.: Wilhelm Knapp.

Drawing Instruments, their Use and Abuse. By Walter G. Stephan. Size, 7½ by 5 in.; pp., 111. Ills. Price, $1. New York: McGraw Publishing Company.

Rocks and Rock Minerals. By Louis V. Pirsson. Size, 7½ by 5 in.; pp., 414. Ills., 110. Price, $2.50, 10/6. New York: John Wiley & Sons; London: Chapman & Hall.

Zur Frage der Erziehung der Architekten und Ingenieure zu Verwaltungsbeamten. By Friedrich Ritzmann. Size, 8½ by 5½ in.; pp., 50. Price, M. 1. Berlin: Julius Springer.

The American Practice of Gas Piping and Gas Lighting in Buildings. By Wm. Paul Gerhard. Size, 9 by 6 in.; pp., 306. Ills. Price, $3. New York: McGraw Publishing Company.

Telephone Law; the Organization and Operation of Telephone Companies. By A. H. McMillan. Size, 8½ by 6 in.; pp., xiv, 331. Price, $3. New York: McGraw Publishing Company.

Bricklaying System. By Frank B. Gilbreth. Size, 9 by 6 in.; pp., xi, 321. Ills. Price, $3. New York and Chicago: The Myron C. Clark Publishing Co.; London: E. & F. N. Spon.

Electric Motors, their Installation, Control, Operation and Maintenance. By Norman G. Meade. Size, 7½ by 5½ in.; pp., 159. Ills. Price, $1. New York: McGraw Publishing Company.

Gas, Gasoline, and Oil Engines, Including Producer-Gas Plants. By Gardner D. Hiscox. Size, 9 by 6 in.; pp., 476. Ills. Price, $2.50. New York: The Norman W. Henley Publishing Company.

House Painting, Glazing, Paper Hanging and Whitewashing. By Alvah Horton Sabin. Size, 7½ by 5 in.; pp., 121. Price, $1. New York: John Wiley & Sons; London: Chapman & Hall.

The Theory, Design and Construction of Induction Coils. By H. Armagnat. Translated and edited by Otis Allen Kenyon. Size, 8½ by 5½ in.; pp., 216. Ills. Price, $2. New York: McGraw Publishing Company.

Bestimmung des Maximalwertes des thermo-dynamischen Wirkungsgrades und der günstigsten Stufenzahl bei Dampfturbinen. By A. Wenger. Size, 8½ by 5½ in.; pp., 84. Ills. Price, M. 3. Berlin: Julius Springer.

Locomotive Engine Running and Management. By Angus Sinclair. Twenty-second Edition. Size, 7½ by 5 in.; pp., xxxvi, 438. Ills., 55. Price, $2. New York: John Wiley & Sons; London: Chapman & Hall.

Telephone Construction, Installation, Wiring, Operation and Maintenance. By W. H. Radcliffe and H. C. Cushing. Size, 7 by 4 in.; pp., 171. Ills. Price, $1. New York: The Norman W. Henley Publishing Company.

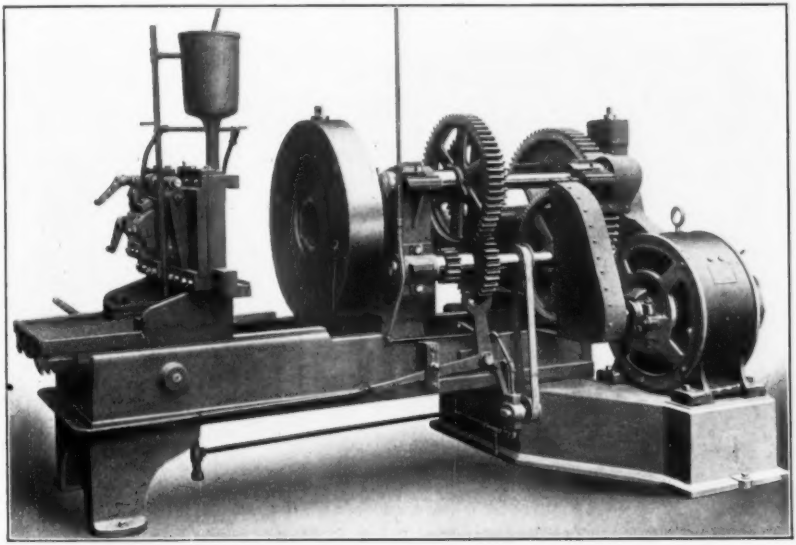
The Building Mechanics' Ready Reference: Plumbers', Steam-Fitters' and Tinners' Edition. By H. G. Richey. Size, 7 by 4 in.; pp., 529. Ills., 201. Price, $1.50, 6/6. New York: John Wiley & Sons; London: Chapman & Hall.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Pipe Threader Driven by Adjustable Speed Motor.

IN securing economy and rapidity of production in many machine tool operations, the individual adjustable speed motor has many decided advantages over other methods of drive. The older methods of speed variation—cone pulleys or gear reductions—provide only comparatively large, rough changes in speed. On the other hand, the adjustable speed motor makes possible fine gradations in the working rate of the tool driven, enabling it to be worked at all times at the proper speed to insure operation at its productive capacity. In many cases the use of the adjustable speed motor has resulted in reducing the cost of the tool taken complete with its adjustable speed motor, aside from the items of increased convenience and improved operation.

The accompanying illustration shows a Westinghouse type "SA" adjustable speed direct current motor driving a machine for cutting and threading pipe from 2½ inches to 8 inches in diameter, built by the Cox & Sons Company, Philadelphia. These machines are designed in sizes to handle pipes up to 18 inches internal diameter, and the special motor drive supplied has proven especially satisfactory. Where quick changes in speed may be required, as in small shops handling a number of different sizes of pipe, such changes can be most easily made with the adjustable speed drive, saving the time lost in shifting gears or belts, and bringing the machine promptly to its most efficient cutting rate. As seen



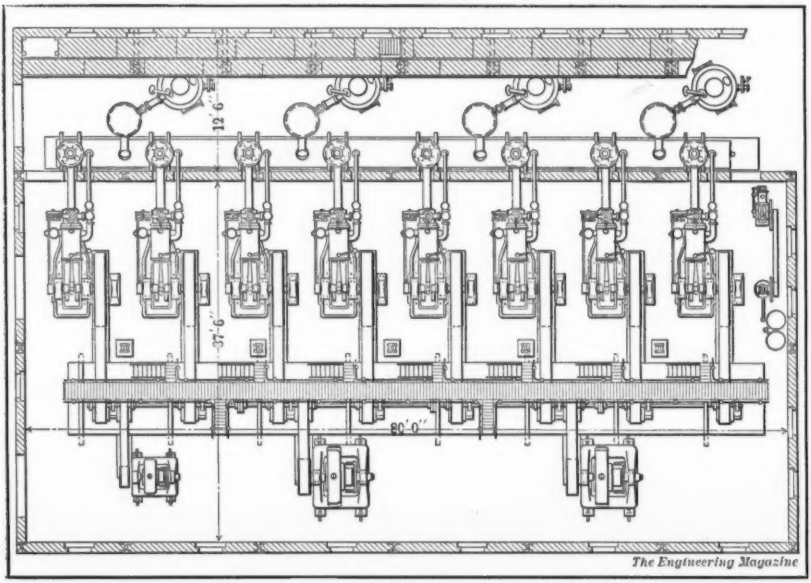
from the illustration, the pipe threader is provided with one set of gear changes, and has an oil system which keeps the cutting tool well flooded with oil. The types of tool holders mounted on the movable carriage are of the most improved design for this class of work. The Westinghouse type "SA" adjustable speed direct current motor gives a speed variation ratio of one to four.

The Gas Engine Power House.

ON page 443 of his "Internal Combustion Engines," Prof. Carpenter says that the hit-and-miss system of governing is theoretically the simplest and, from the standpoint of fuel consumption, the most economical of all systems of governing a gas engine; and on page 554 of the same work quoting from Haeder gives the following table showing variation of fuel consumption with load:

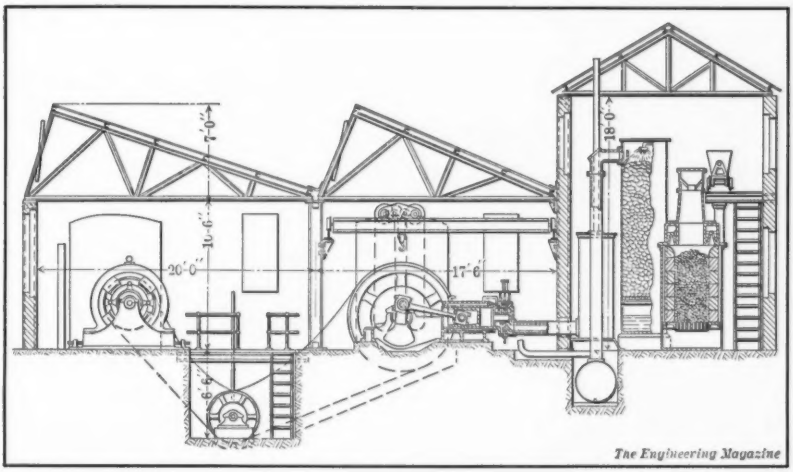
		Variation of Fuel Consumption with Load.								.1 of
Gas Engine.	Max. Load.	.9	.8	.7	.6	.5	.4	.3	.2	Max. Load.
Hit-and-miss regulation	1.	1.03	1.08	1.14	1.23	1.35	1.50	1.8	2.5	3.0
Throttling regulation	1.	1.06	1.13	1.21	1.33	1.50	1.75	2.2	3.0	5.0
Steam plant	1.1	1.05	1.02	1.0	.96	1.02	1.07	1.15	1.30	1.60

Notwithstanding the economic results set forth above as inherent in the hit-and-miss system of governing, it is practically impossible to drive alternators in parallel with any single cylinder gas engine governed on this system, the cyclical irregularity being too great. A single cylinder of the Otto type generates one impulse in four strokes when operating at its maximum power, but as soon as the governor commences to operate there can be but one impulse in eight strokes at the most, and there may be but one impulse in twelve or sixteen strokes. No practical weight of flywheel would suffice to overcome such irregularity of rotative speed due to the intermittent nature of the power application. There is, however, a solution which consist in using multiple cylinders, and heretofore the tendency has been to install tandem and double acting engines. It is not necessary, however, to use either tandem or double acting engines provided a multiplicity of single cylinder engines drive by belt together onto one common jack-shaft, and if the



flywheels are slightly different in diameter there will be no possibility of all the impulses of all the engines "phasing" together. In this way four or more single cylinder gas engines, even though single acting, can be used to drive one common generator.

The load factor in very many installations is constantly varying during the



day. Sometimes the load in the early morning hours will be ⅛ of the maximum load, and the maximum load will last for but two or three hours out of the twenty-four. With any power plant, whether steam or gas driven, where such fluctuations exist, it is impossible to attain the highest coal economy unless the power installation is sub-divided as many times as the maximum load is times the minimum load. While this statement is practically true of a steam plant, it is peculiarly true of a gas plant, since the gas engines' greatest economy is obtained only when it is giving its maximum power. An inspection of Haeder's table shows that when a gas engine operates at half load its fuel consumption increases 35 per cent. Fortunately a gas engine is just as economical in small units as in large,—that is to say a 50 H. P. engine can give a H. P. on substantially the same fuel consumption as a 500 H. P. or a 5,000 H. P. engine. It is for these reasons that the designs of a power house shown herein has been prepared. The gas engine installation consists of eight single acting engines of the Otto type. Each engine drives by belt or rope onto a friction clutch pulley on the jack-shaft. Consequently it is possible to engage or disengage any one of the eight engines at any moment. All the gas engines draw their gas from one common gas tank which is shown occupying a concrete trench, and has an abundant capacity to prevent any pulsation in the gas suction pressure. Separated by a fire proof brick wall from the engines are the producers with their accompanying scrubbers. Each one of these producers is capable of 100 per cent. overload and 50 per cent. underload without materially impoverishing the richness of the gas generated. Even when all eight engines are running simultaneously three of the four producers can readily furnish all the gas needed for the maximum demands of these eight engines indefinitely, so that the fourth producer and its scrubber may be put out of business, dismantled and cleaned without interfering with the continuous performance of the plant at its maximum output. Also any one of the four

producers can be considered to furnish gas for any one of the eight engines.

The jack-shaft is supported on slabs of concrete, insuring the permanence of the alignment of its bearings, and every pulley on the jack-shaft is a friction clutch pulley. It is accordingly possible for the attendant to bring into service or cut out of service any one of the eight engines according to the demands of the moment. For two or three hours of the twenty-four but one engine and the smallest electric generator may be in service, provided this latter is a direct current and not an alternating current generator.

Because of the flatness of the efficiency curve of the electric generators from full load to half load, the electrical generating plant has been divided into but three units, the smaller to be driven by one engine at half its capacity, by two engines at its full capacity, the two larger units to be driven each by two engines at half their capacity and by four engines at their full capacity. With such an outfit it will be possible to keep the fuel consumption down below one pound per B. H. P. hour all the time the reliability of the installation is evident. Such a plant can be operated for twenty-four hours out of the day and for every day in the year. The chances of any serious simultaneous breakdown that would put more than one engine out of business are very small. The fact that the tension side of the driving belts is tending to lift the jack-shaft vertically upward, thereby reducing the pressure on its bearings, is will worth noting. As far as the economy of the electric installation is concerned it should be borne in mind that direct connected generators can only be run at half the speeds possible in the case of these belt-driven generators, so that there is a saving in the cost of the electric generators as an offset against the cost of the jack-shaft and the friction pulleys. The strongest argument in favor of such a plant is undoubtedly its great reliability, and when its superior economy in fuel is considered, amounting to as much as a saving of one-third, it certainly should appeal to power users. This installation was designed by John L. Bogert, engineer of the New York Engine Co., 165 Broadway, New York.

A New Gasoline Blow Torch.

THE illustration herewith shows the extra heavy form of gasoline blow torch, designed for extra heavy heating and brazing, such as propeller shafts, heavy frame-work, steel plates on boilers, hulls of ships and work of similar nature, for heating defective castings in foundries, which is necessary for patching,

plugging and adding missing parts; for brazing the ends of rails together, such as is practiced by street railways and electric railroads to make a secure electrical joint, for releasing and making shrinking fits on heavy machinery and engines, for brazing large iron or copper tubing, for straightening buckets and steel girders, such as are in use by iron ore and coal docks and many other purposes.

It will heat a solid 11½-inch round shaft red hot in about 20 minutes, and to a brazing heat in from 50 to 55 minutes if the heat is properly confined to the work. It will heat shafts up to 24 inches in diameter red hot with a single burner and will make and release shrinking fits of large proportions without any exertion or air pump. In a machine shop it is especially useful in repair work for ex-

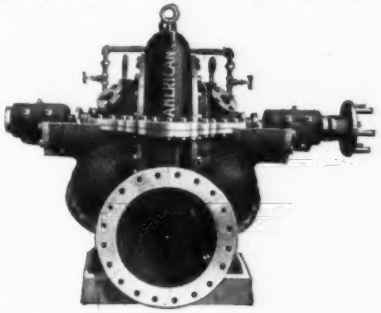
tracting broken taps and drills from work, for brazing broken parts of castings, tools and machinery, for heating shafts between lathe centers for straightening, especially such as armature and crank shafts, a task which is easily accomplished by placing the torch on top of the lathe.

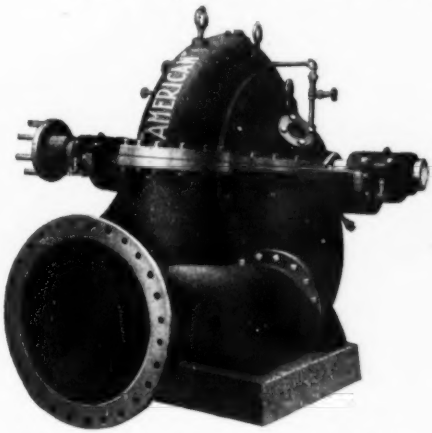
The steel cylinder of the main body is brazed and staybolted, and capable of sustaining a pressure of over 2,000 pounds per square inch. It can be operated between 10 and 200 pounds and will easily maintain a working pressure of from 80 to 140 pounds without any exertion, or the use of an air pump.

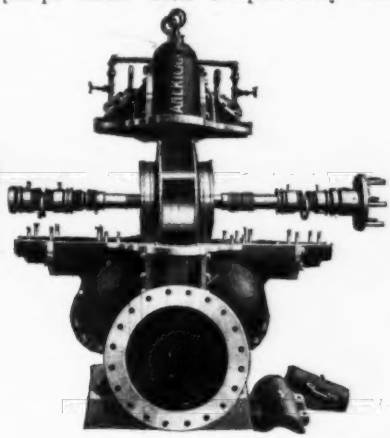
These torches are made in many forms by the Manufacturers' Supply House, Erie, Pa., who will send an interesting booklet on brazing on application.

High-Efficiency Centrifugal Pumps.

IN September of last year efficiency tests were made by Arthur L. Adams, M. Am. Soc. C. E., of San Francisco, on two centrifugal pumps of the American Well Works, intended for use as part of the pumping equipment for irrigating 14,000 acres of land in the San Joaquin Valley, Cal., all of which will be furnished by this company. The pumps tested were of the sizes designated as "20-inch" and "15-inch," these dimensions corresponding with the diameters of the suction connections at the point of inlet into the main casing. The results, which are given in full in a recent pamphlet issued by the company, show that at 288 revolutions per minute, lifting against a head of 26.85 feet, the 20-inch pump had an efficiency of 75.6 per cent; while at 330 revolutions per minute, lifting against a head of 22.69 feet, the 15-inch unit had an efficiency of 77.4 per cent. The lower efficiency of the larger pump is attributed by Mr. Adams to an error in assembling not discovered until after the runs had been made. He characterizes the performance of these pumps under such comparatively low heads as were used in the tests as very gratifying.







In the "American" centrifugal there is no sudden change of direction of fluid

in passing through the pump. The flow is constantly forward in a continuous easy curve and the fluid is discharged in a fraction of a single revolution of the impeller. The impeller is accurately made and machined true to fit the casing, preventing backflow. The double intake equalizes the end thrust and the impeller is balanced to run perfectly true. At the entrance of the discharge pipe is a cut-off which prevents fluid passing the discharge pipe and being repumped. The inner end bearings are provided with water seals to prevent intake of air. The main outer bearings are equipped with ring oilers, keeping the bearings constantly lubricated from oil cellars.

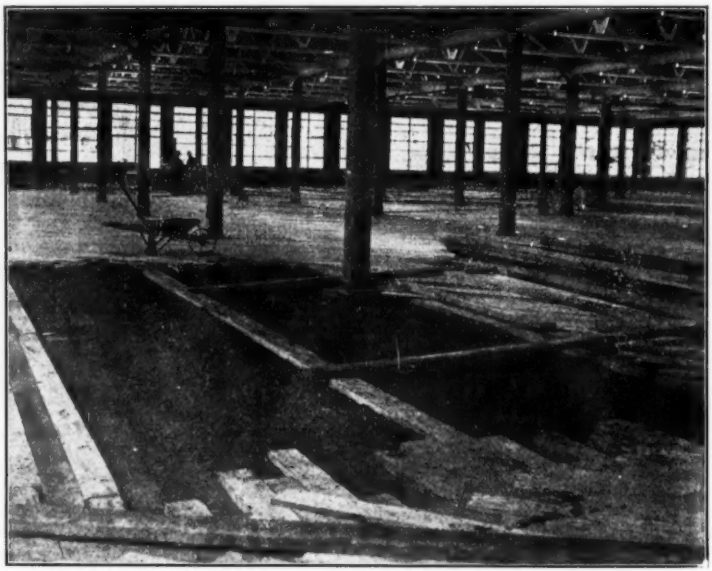
These features not only make "American" centrifugals more efficient, but, in locations favorable for installing this kind of pump, they are most economical.

"American" centrifugals are made in both horizontal and vertical styles, in any number of stages, in any size, and equipped with any power.

The catalogue describing these pumps contains much information not found in any other book on hydraulics and the American Well Works, Aurora, Ill., will send a copy free on request.

An Ideal Factory Floor.

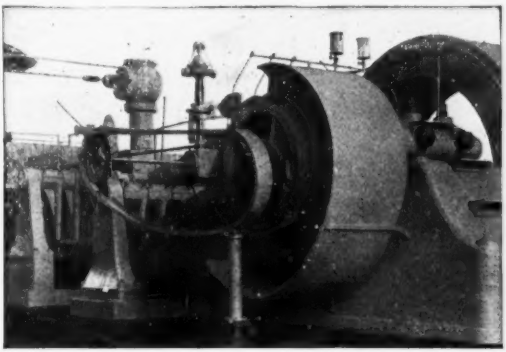
THE facility with which mill and other machinery can be fastened to a wooden floor, gives rise to the use of such floors, even when the balance of the floor construction or the necessary strength is obtained from re-inforced concrete. The usual method of construction in such cases has been to bed



wooden nailing strips in the concrete flush with the surface and nail the floor planks to these strips. In making the plans for the Blake & Johnson factory at Waterville, Conn., the engineers, Griggs & Hunt, of Waterbury, Conn., were confronted with the requirement of a 4-inch wooden floor on the second story although the floor panels themselves were to be of re-inforced concrete. The usual practice of using nailing strips as mentioned above was at first considered, but there is always danger of dry rot where wood is embedded in concrete, and protection against dry rot was essential.

The method adopted was similar to that used under the lower floor in many factory buildings, and seems so admirably adapted to the requirements that it is strange that it has not occurred to others to use it where the wooden floor is required on top of concrete.

For twenty or thirty years it has been the practice where a wooden floor is required directly on the ground without space beneath to omit sleepers and bed the plank directly on from 1 inch to 2 inches of sand mixed with sufficient good heavy coal tar to fill the voids in the sand. This not only protects against decay that would be caused by dampness from the ground, but the creosote oil in the tar also acts as a wood preservative. The foundation has often been of concrete but more usually of cinders or broken stone or gravel, mixed with enough tar so it would compact well under a roller and provide a good, true and level surface for spreading the sand and tar. The mixture of sand and tar provides a perfect bedding for the planks, which are tied together as firmly by the hardwood wearing surface laid at right angles or diagonally as a single floor would be by the use of sleepers. The adoption of this idea on the second floor of the Blake & Johnson factory is shown in the accompanying view. In this case the foundation (the re-inforced slab) was already in; all that was needed was something on which to bed the planks. Sand alone would not answer, as vibration would cause it to shift; but by mixing tar with the sand this danger was overcome and the protection afforded by creosote oils in the tar was obtained. Barrett's sub-floor tar No. 5 was used and about fifty gallons mixed with each cubic yard of sand. The mixture was spread on about 1⅛ inches thick, so it would compact to 1 inch, levelled with a straight edge and while it was still warm and soft the planks were laid on it and tamped until the proper level and stability were obtained. Following the 2-inch plank a ⅞-inch rough pine board was laid and then a surface of 1¼ inches square edge maple. If the experience of twenty or thirty years counts for anything, the planks in this floor will last as long as any part of the building, and if the hardwood wearing surface wears through in places, repairs will be a simple matter.



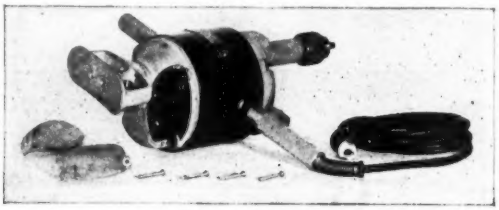
Chain Governor Drive for Close Regulation of Steam and Gas Engines.

BELTED drives on steam or gas engine governors are often a source of much trouble owing to stretch of the belting and the spattering of oil upon its surface. The belting requires close attention, for if belt slip is permitted, the engine becomes irregular.

The William Tod Company has for several years employed machine cut chain and sprocket governor drives as a means of overcoming these difficulties. The arrangement of sprockets, shafting and bevel gears by means of which an absolutely positive speed ratio is maintained between main and governor shafts is clearly shown in the illustration.

This particular drive is also interesting as a part of the largest tandem compound engine ever built,—52 inch x 90 inch x 60 inch. This engine was made to drive a 43-inch three-high blooming mill in the Youngstown, Ohio, works of the Carnegie Steel Co. It is rated at 4,000 H. P., but delivers a peak load of 15,000 H. P., which is accomplished by means of a 24-foot flywheel weighing 120 tons. The engine is, of course, de-

pendent upon the governor for successful operation and the duty of the governor drive in steel mill work is unusually severe, owing to the sudden variation of load. Chain has proven to be the only drive that insures close governing and absolute dependability. In the illustration, the outboard bearing, flywheel, main shaft, driving sprockets and the chains are removed to show the governing mechanism better. The position of the chains in service is indicated by that of the chain guard. It will be noticed from the double driven sprocket and the width of the chain guard that two chains are used.



These are of the standard roller type similar to the ones used in automobile service and are made by the Diamond Chain & Manufacturing Co., Indianapolis, Ind. A single chain transmits sufficient power to drive the governor shaft, but the second chain is added so that one chain will always be working in case of an accident to the other. The chains, however, have never given trouble from any cause, and they require no attention save an occasional oiling.

Machined chain has met with considerable favor in many places where belting has failed. In driving milling machine feeds or parts of automatic machines where accurate timing is essential, chain is superior to belting. On slow and medium speed drives with short center distances, chain transmits practically all the power where a belt to do the same work would require a high initial tension. There being no possibility of slip with chain it can be run without initial tension, thus diminishing useless journal friction, the danger of hot boxes, the strain on shafting, and the amonut of lubricant required.

Alternating Current Portable Drill.

THE practice of taking heavy castings to a stationary drill, of spending much valuable time in adjusting them in order that a few brief moments may be spent in drilling is an instance of the wasteful methods that eat into the profits.

The direct current portable breast drill designed by the General Electric Company has met with great favor, and has so satisfactorily demonstrated its ability to do the work for which it was designed that they are now manufacturing an alternating current one, which possesses all the superior features of their direct current drill, and permits the use of this device where alternating current only is available. It possesses the ruggedness of design required to withstand the hard usage incidental to its service, yet its weight has been reduced to a minimum, being but 21 pounds, ensuring that the device may be handled by one person with great ease and rapidity. Two gnurled side handles and a breast plate provide ample means for holding it securely in any position. An indicating control switch for starting and stopping the motor is located conveniently near the right handle, so that it can be operated by the right hand without releasing the hold on the right handle. This feature makes control of the apparatus so simple that the whole attention may be given to the operation of the drill. Hand holes are provided, which furnish a means of easy access to the commutator and brushes for inspection and repairs

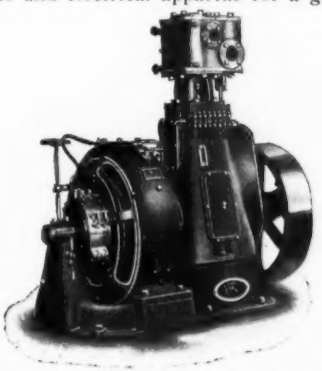
if necessary. The drill is fitted with a Jacob's chuck, which will take drills up to and including ⅜ inch in diameter. An idea of the great saving of time made possible by its use may be gained from the following approximate data: it will drill a ⅜-inch hole 1 inch deep in cast iron in 27 seconds; in machine steel in 95 seconds. It will also satisfactorily operate a ¾-inch wood bit.

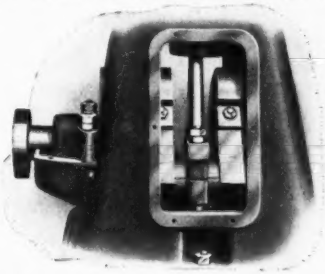
Compare this with the time required to move heavy castings to a stationary drill, adjust them, drill one hole, adjust again, drill another, etc. In general a crane will be required, necessitating the services of several men in addition to the one operating the drill. In many cases the same work could be done in a few minutes by one person with a portable drill.

It is designed for operation on a 110 or 220 volt 60 cycle circuit, to which it is connected by screwing the attaching plug into a standard lamp socket.

A New Generating Set.

THE generating set described below is specially designed for use in isolated plants, upon shipboard, and in all places where a thoroughly reliable, high grade, efficient, quiet running generating set is necessary. It is the latest product of the B. F. Sturtevant Company, Hyde Park, Mass., who have been building engines and electrical appartus for a good many years. The set consists of a generator of either the six or eight pole type, depending upon the size, attached to the same sub-base and direct connected to the new Sturtevant vertical single engine known as class VS-7. This engine is the result of over fifty years' experience in engine building, and in manufacturers claim that in this model they have retained the best and eliminated the objectionable features of their previous designs, and have also added many other details of construction which tend to make a thoroughly high grade quiet running engine.





This engine is of the high speed enclosed type, the reciprocating parts being enclosed within the frame which is provided with openings through the front, back, and sides, of sufficient size and in just the right position to permit ready access for inspection or adjustment. These openings are fitted with dust proof covers which may be easily removed. A water shed partition prevents the oil from the frame being carried into the cylinder and the water in the cylinder being carried into the frame. This water shed partition together with a piston rod stuffing box, are located in a distance piece which separates the cylinder from the frame. Access to these parts is readily obtained through openings in the distance piece even though the engine is in operation.

The lubricating system, of the gravity type, consists of a reservoir cast in the top of the frame from which the oil flows to all bearings through piping equipped with sight feeds All the oil not used flows into a reservoir cast in the sub-base. It is filtered through fine screens and forced to the top reservoir by a durable, efficient, pump located in the sub-base and entirely submerged in the oil. The engine may be run independently of the oil pump by filling the

top reseroir through an opening provided in the frame and drawing off the excess oil from the bottom reservoir through a drain cock.

A Rites inertia governor placed in the balance wheel regulates the speed so accurately that the variation between no-load and full-load is not more than 1½ per cent.

The generator armature is of the iron clad, two circuit, ventilated drum type and is pressed upon the shaft. The armature coils are form wound and are thoroughly protected against oil and water. The commutator is made up of segments of pure, hard drawn copper insulated with amber mica of such hardness that it will wear uniformly with the copper. These segments are secured in a steel ring and insulated therefrom by rings of hard mica. Armature conductors, commutator segments and brushes are proportioned to give low current density, thus insuring low temperature rise, high efficiency and good operation. The brush rigging is arranged so that the brushes may be adjusted separately or may be adjusted simultaneously by revolving the brush ring.

The magnet frame is of cast iron and is divided on a horizontal plane. The pole pieces are of wrought iron and together with cast iron shoes are through bolted to the frame. The field coils are made up in two sections, the compound winding forming one section and the shunt winding the other section. They are machine wound and of open construction to secure maximum radiation and ventilation.

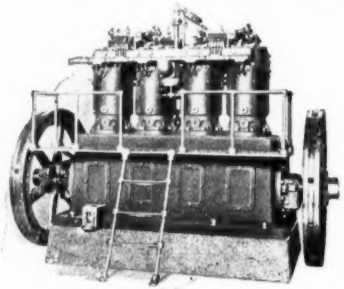
Only the best material obtainable and the most careful and expert workmanship enter into the construction of these sets which are thoroughly tested and subjected to the most rigid inspection before leaving the company's works.

Bulletins Nos. 171 and 172 describing these sets in detail may be had by addressing B. F. Sturtevant Company, Hyde Park, Mass.

The Merriam Gas Engine.

THE accompanying illustration shows an elevation and section of the Merriam gas engine built by the Bruce-Macbeth Engine Co., Cleveland, Ohio, successors to the Bruce-Merriam-Abbott Co. and the Macbeth Iron Co.

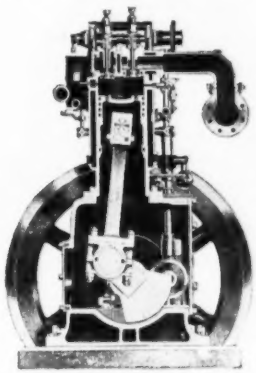
The cylinders are completely water-jacketed and cast separately. Each is



bored to an accuracy of a thousandth of an inch and micrometer dimensions taken and stamped on the upper edge. They are supported on the crank chamber by heavy flanges, reinforced with extra strong ribs, cast integrally with the cylinders. This construction is heavier than is usually found in such engines, and makes the cylinders absolutely rigid and free from vibration at all times. The piston is of the trunk type, and made extra long, providing for minimum wear and greatly prolonging its life. It is fitted with five snap rings made from cast iron and machined eccentric to insure uniform strength and perfect fit to the cylinder, thus giving absolute compression and assuring maximum efficiency and allowing the engine to be subjected to heavy overload. The crank chamber consists of a heavy casting thoroughly ribbed and accurately planed for the support of the cylinders. It is bored throughout its entire length at one setting, thus providing perfect alignment of crank shaft bearings. The crank chamber is easily accessible through cover plates at the front and doors in the rear to permit inspection

and adjustment of the crank shaft and connecting rod bearings.

The valve stem is so designed as to eliminate the use of thread and nut, in place of which steel blocks are used. These blocks are machined to fit the square portion of the valve stem. The exhaust valve is water-cooled, thus preventing overheating and insuring perfect lubrication. The air port is below the gas port and the valve is so made



that a portion of air enters the cylinder in advance of the mixture of gas and air. This prevents back firing.

The characteristic prominent in the construction of the Merriam engine is the unit design of the operating mechanism. The operating unit opens and closes the inlet and the exhaust valves and operates the ignition mechanism. The unit consists of a cam shaft made from a high carbon steel forging on which the cams are machined, each in its proper position, so that when the valves are properly adjusted there is no possibility of any change due to the cams slipping. The cams act on rocker arms, fitted with set screws for the adjustment of the valves, and the rocker arms are equipped with cam rollers operating on hardened steel bearings. This construction eliminates the use of push rods and other moving parts and consequent wear and noisy operation. The operating unit is driven from the governor shaft through a pair of steel bevel gears and the igniter contact cam and distributor is mounted on the forward end of the cam shaft. The advantage obtained by this unit method of design is that all parts of the operating mechanism are easily accessible for inspection and cleaning. Positive and practically noiseless operation is assured and the entire mechanism can be removed from the engine without dismantling other parts.

The governor is of the centrifugal ball type mounted on a steel shaft supporting and driving governor balls, which control the engine speed. The entire governor mechanism is easily removable from the engine without disturbing other parts. The design of the governor weights and springs is worked out to assure perfect regulation of engine speed and high economy in fuel consumption under all working loads.

The ignition apparatus consists of two complete and independent systems, each supplying a separate spark. Each cylinder therefore receives two sparks at the proper time, either one of which is sufficient to cause combustion. The distributor consists of a timer constructed with hardened steel cam mounted on the forward end of the cam shaft in the operating unit. The purpose of this cam is to make and break a contact between two copper pins submerged in a bath of kerosene oil held in a cup attached to the timer. The sparks produced by this apparatus are distributed to the proper cylinders through cables supported by hard rubber blocks.

The splash feed system of lubrication is employed and a liberal amount of oil is carried in the bottom of the crank chamber, the exact amount of which is visible through a plate glass cover. The engines are started by compressed air.

The Bruce-Macbeth Engine Co., Cleveland, Ohio, have just published a well-illustrated catalogue showing the several parts in detail and giving much other information, which they will send to inquirers on request.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Expansion Bolts.

STAR EXPANSION BOLT CO., 147 Cedar Street, New York City.—Descriptive catalogue of "Star" expansion bolts, single and double expansion, for use with machine bolts and screws, wood screws, or lag screws, for attaching securely to metal, stone, brick-work, concrete, wood, etc.

Feed-Water Filter.

AMERICAN STEAM GAUGE & VALVE MFG. CO., Boston, Mass.—Description of the American H_2O grease extracting feed-water filter for marine and stationary engines.

Fuel Economizers.

B. F. STURTEVANT CO., Hyde Park, Mass.—Catalogue No. 150, describing Sturtevant fuel economizers and air heaters This type of economizer with all joints metal-to-metal will stand working pressures up to 300 pounds per square inch, and the doing away with gasket joints eliminates chance of leakage. A new design positive scraper mechanism prevents sticking of the scraper, which eliminates one of the troubles found in earlier designs of economizers.

Gauges.

SCHAEFFER & BUDENBERG MFG. CO., Brooklyn, N. Y.—An extensive catalogue on pressure and vacuum gauges, and instruments of precision for measuring pressure, temperature and speed. An interesting instrument shown is the draught gauge for measuring the draught in flues of steam boilers. The influence of the chimney upon the working and economy of a steam-power plant is a factor of the greatest importance. Its functions are to furnish sufficient draught properly to burn the fuel and to carry off the products of combustion. This gauge is of very simple construction and not liable to derangement. It is fitted with a large and easily read dial, usually graduated to one inch, and readings in hundredths of an inch can be taken.

Graphite Lubrication.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.—A booklet entitled "Graphite as a Lubricant." This eleventh edition is more compact than its predecessor, the idea being to concentrate information in convenient form. It deals particularly with the lubrication and treatment of power-house requirements.

Lubricator.

DETROIT LUBRICATOR CO., Detroit, Mich. —A booklet illustrating the Detroit bulls-eye locomotive lubricator, and containing full descriptions of the various types and sizes, together with information relative to installation, operation, care, etc.

Portable Elevator.

N. Y. REVOLVING PORTABLE ELEVATOR CO., Jersey City, N. J.—Descriptive catalogue of a revolving portable elevator intended for use in warehouses, factories, mills, storehouses, or other places where boxes, barrels, bales, cases, etc., are handled. Moves objects weighing up to 1,200 pounds and raises them to any required height up to 10 feet. It makes possible the use of all the storage space in a warehouse or other building without the tremendous physical labor necessary in hoisting or tiering boxes, barrels, or bales in the usual way. The upper part can be folded over to pass through low doorways.

Pulleys.

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THE ENGINEERING MAGAZINE

1910

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CHARLES B. GOING AND FRANCIS G. WICKWARE

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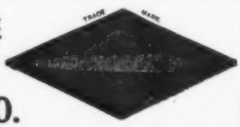

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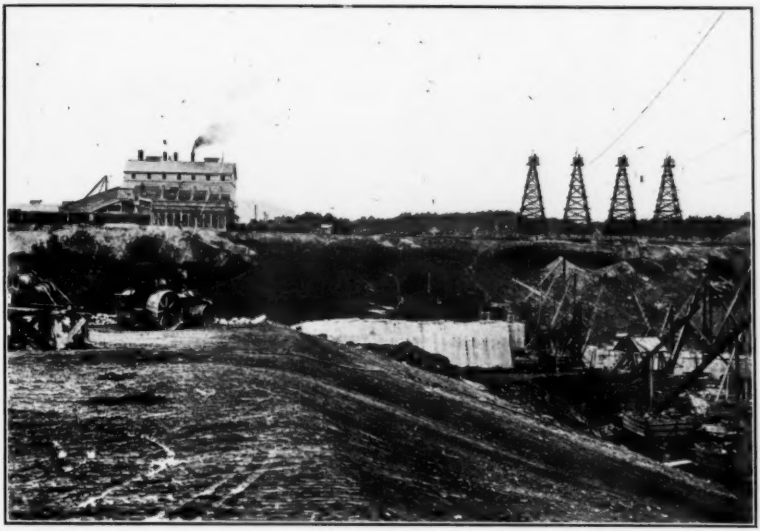

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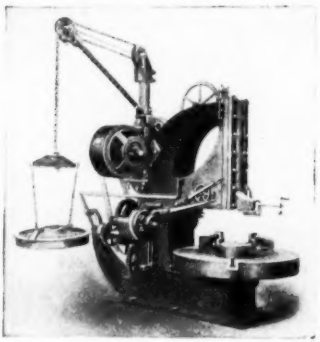

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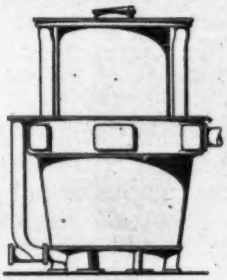

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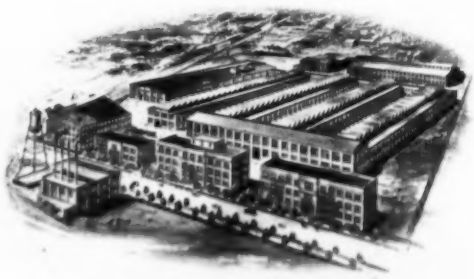

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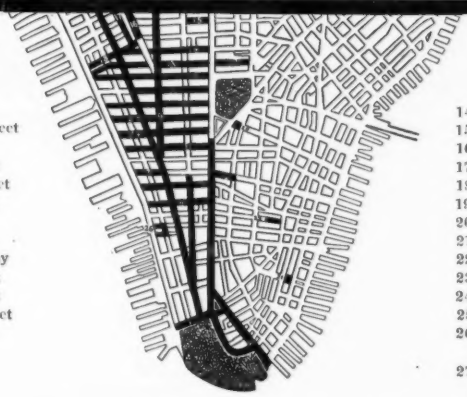

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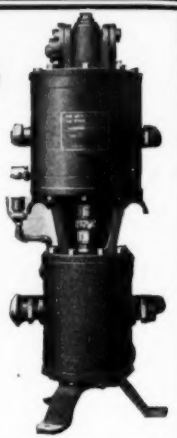

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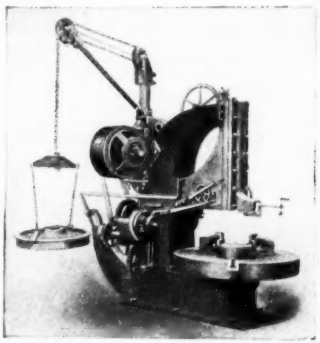

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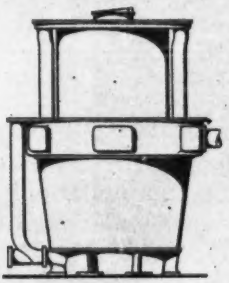

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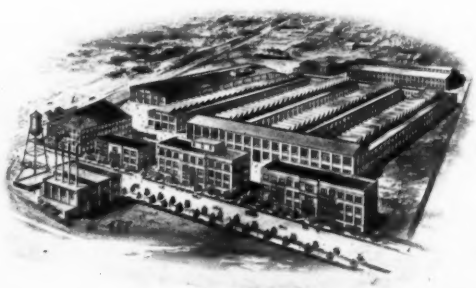

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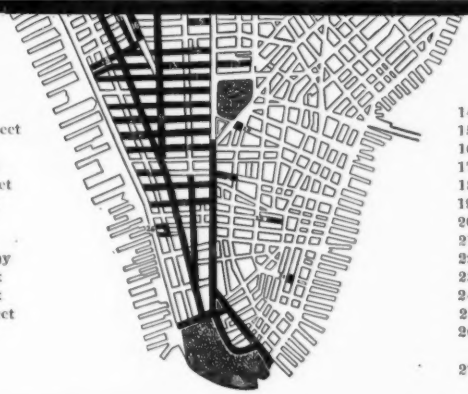

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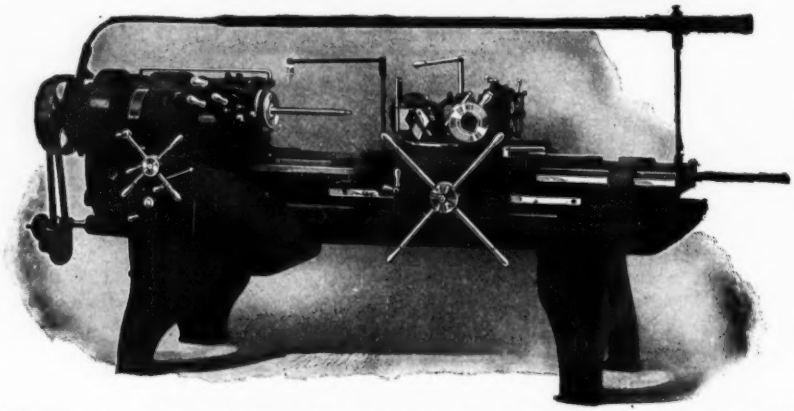

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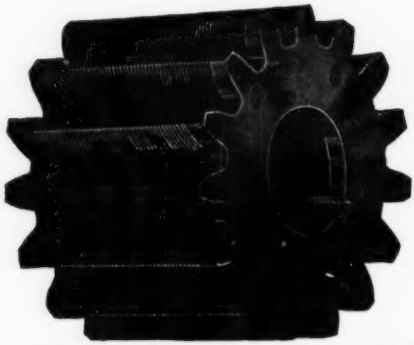

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THE ENGINEERING INDEX

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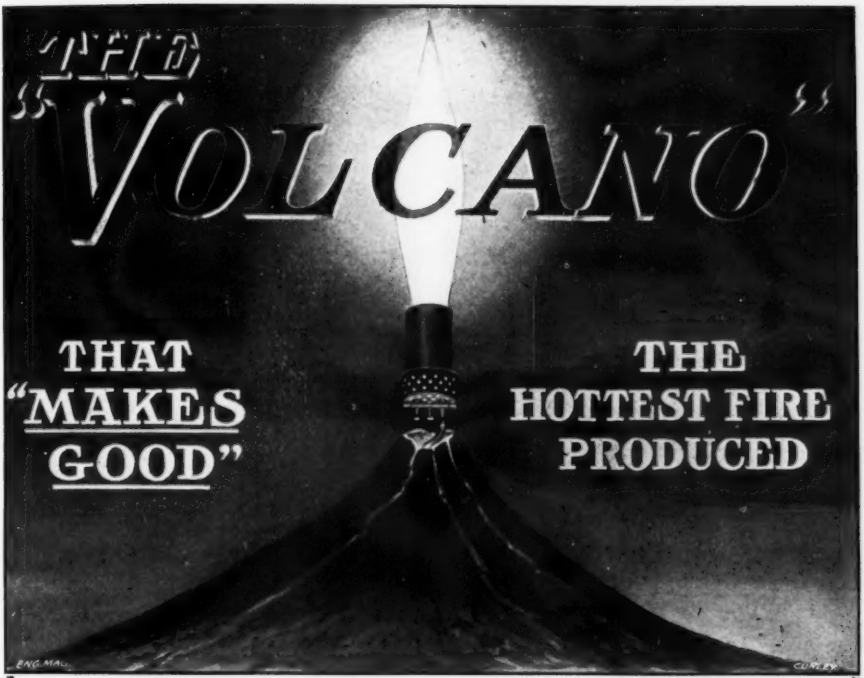

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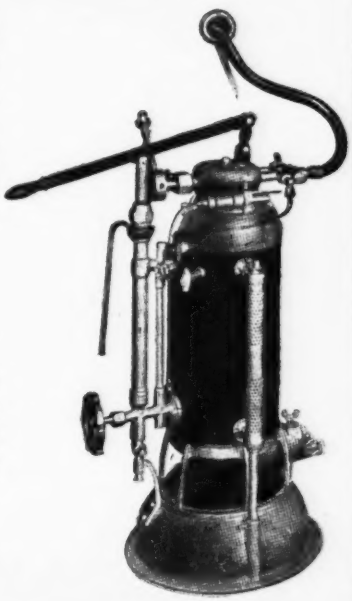

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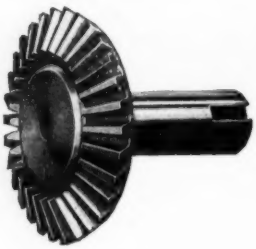

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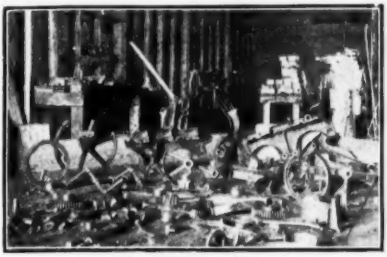
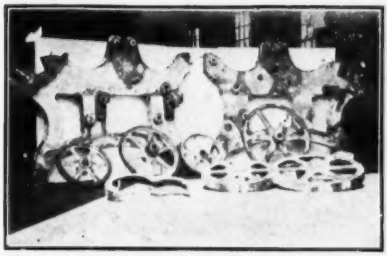
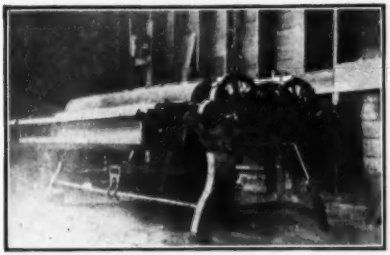


125 Broken Parts



The Same Parts Reduced to 8 Ready for Assembling



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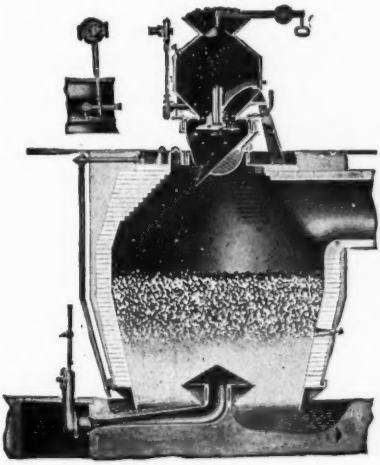

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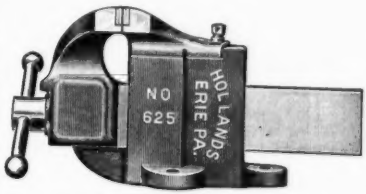

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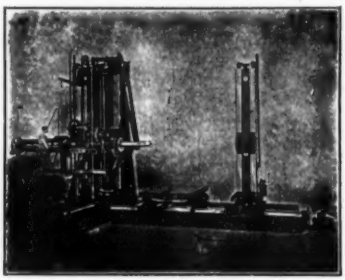

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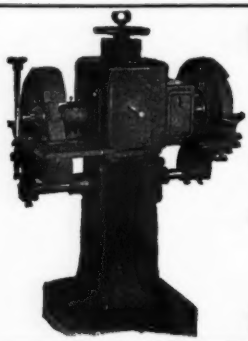

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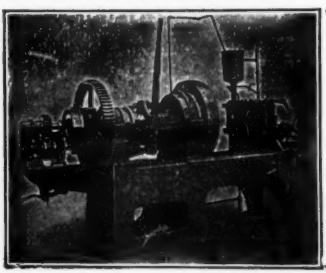

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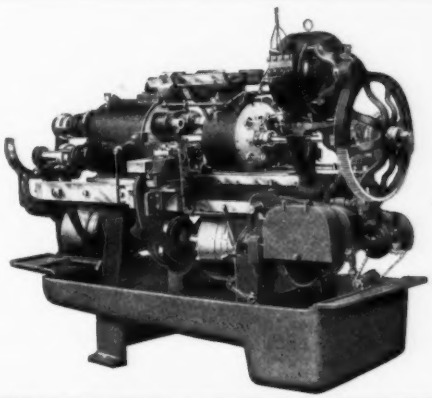

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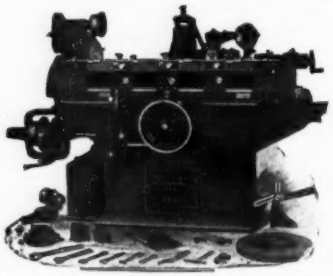

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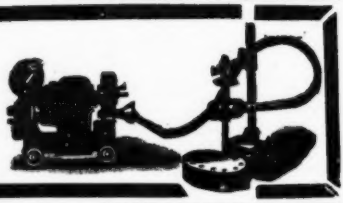

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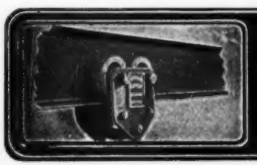

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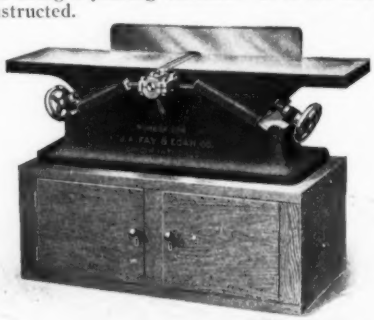

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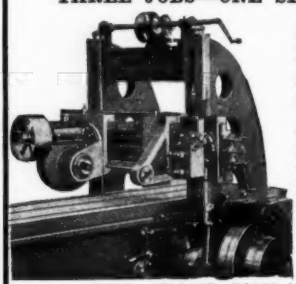

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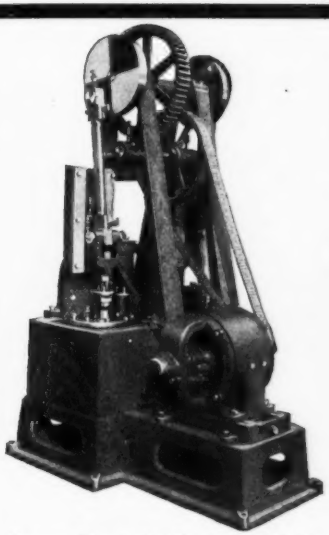

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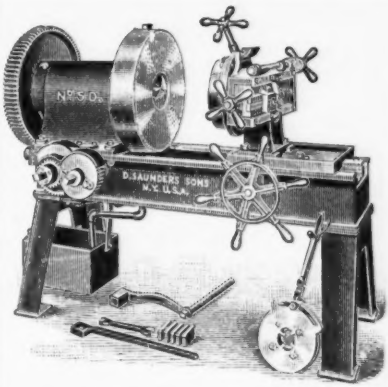

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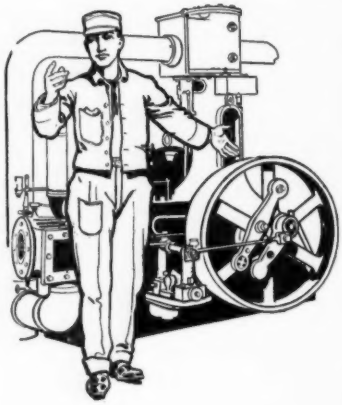

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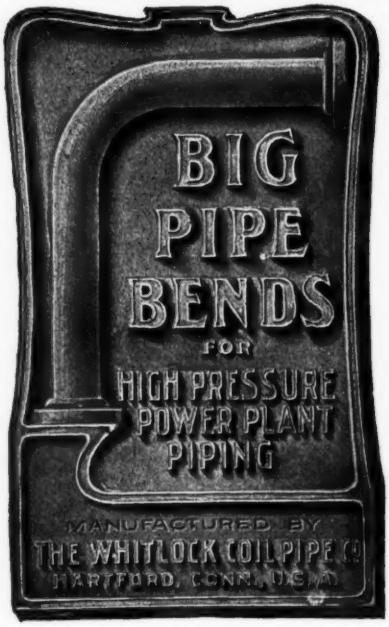
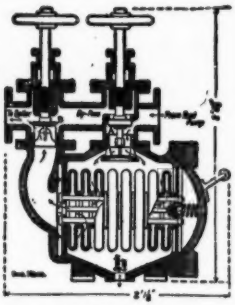


Keep Out Oil.



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It is extensively used both on land and sea.

Send for illustrated circular giving details and list of principal users.

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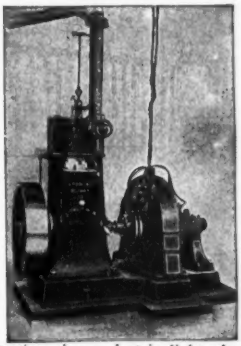

Illustration shows electric light plant at Iquitos, Peru.

These remarkable engines are designed for high speeds and continuous operation for 2 to 6 months without oiling or adjustment.

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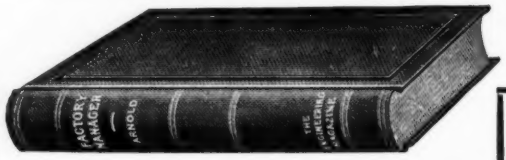

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The one aim of "The Factory Manager" is to explain the methods of highly successful factory and shop managers.

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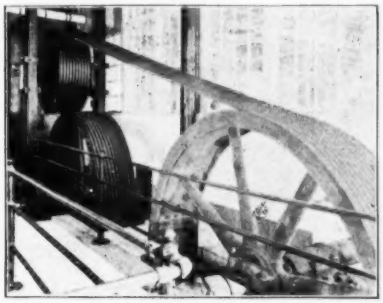
Our experience with rope transmission covers more than twenty-five years. During that time we have designed and installed Dodge Rope Drives for widely different kinds of service.



Dodge Reverse Motion Rope Drive.

Many of these drives are working under ordinary conditions. Transmitting power from engines to jackshafts, generators and special machines, and from jackshafts to line shafts.

And some of them have solved difficult transmission problems and become real engineering achievements. For example, the nine and ten feet center rope drives to roll lines in rubber mills. Some years ago we designed the first drive of this kind. It made such a reduction in waste power, noise and expense over the grear trains it replaced that short center rope drives were adopted as the standard in rubber mills, and we have since furnished many of them.

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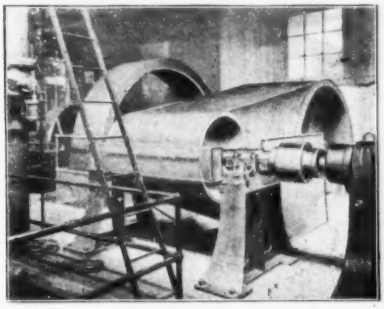
But if you have a difficult power transmission problem, advise us fully about it.

Let our engineers go over your data and sketches. If they decided that a Dodge Rope Drive is the best method, we will prepare plans for a drive, based on our experience in this line.

And we will warrant the drive shown by our plans to operate with least power waste, noise and maintenance cost.

Write us the conditions at your plant, send sketches, and secure the information that we can furnish.



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Our Bulletin I-76, "Twenty-Five Years of Rope Driving," contains valuable information for owners, managers, superintendents, purchasing agents and master mechanics of power-using plants. To men in such positions we will be glad to send a copy without charge. Use coupon or write us.

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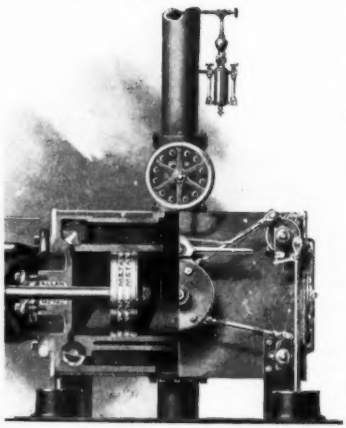
Trouble in the Cylinder



Excessive friction and wear are by far more expensive wastes in the cylinder than in any other part of the engine. They consume its life's energy directly when it is in its prime.

For years we have claimed, and by thousands of applications of Allan Metal to pistons have proven, that cast iron bull rings working in cast iron cylinders greatly increase friction and wear.

There is but one proper construction for pistons. They should be faced with a metal having excellent antifriction qualities, a melting point sufficient to resist the heat conditions in the cylinder and having a contraction and expansion about equal to cast iron. A metal having these qualities, you will agree, must give better results than cast iron against cast iron.

Our booklet "The Heart of the Engine—The Seat of Power" is a treatise on pistons—Ask for it.

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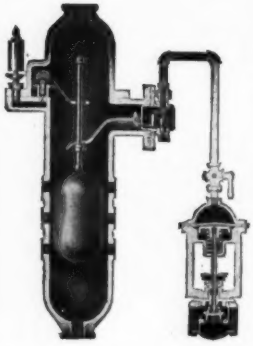

WILLIAMS SAFETY FEED WATER REGULATOR always reliable; controls the flow of feed water to the boiler, with efficiency and regularity more than human, every one of the 24 hours of the day—every day of the year. It has a service record of eight years continuous use with practically no repairs. That shows of what good stuff the Williams is made. Has no springs, expansion tubes, stuffing-boxes, or rotary valves to become deranged and cause trouble.

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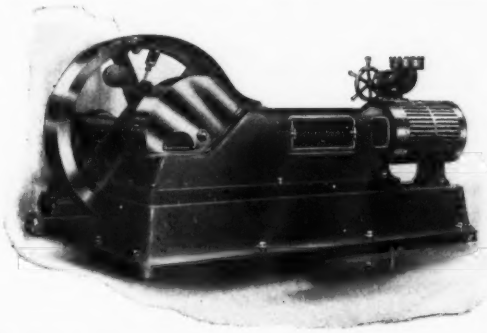

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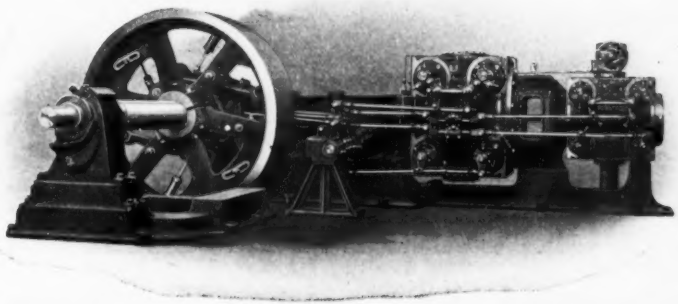

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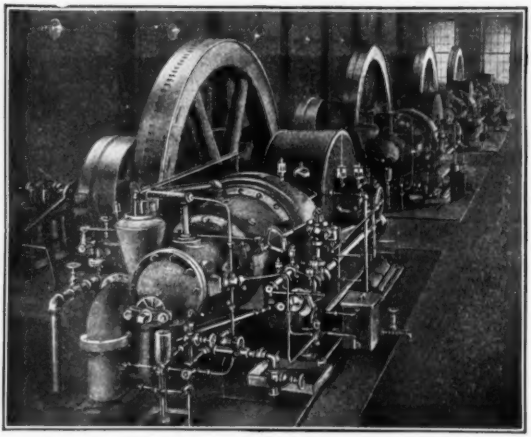

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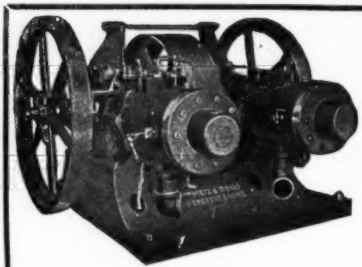

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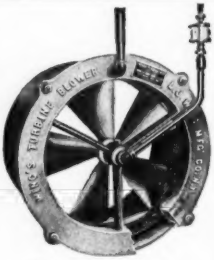

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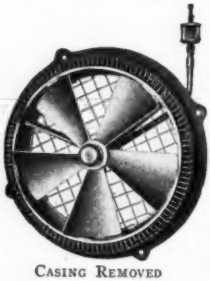

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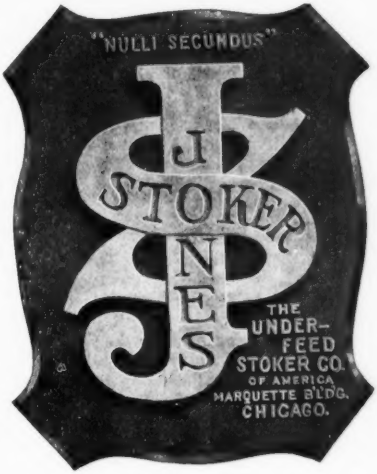

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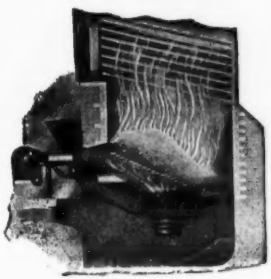

The incandescent fuel floats on green coal which covers stationary air-cooled tuyere blocks. No moving parts get more than comfortably warm.

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Sturtevant VS-7

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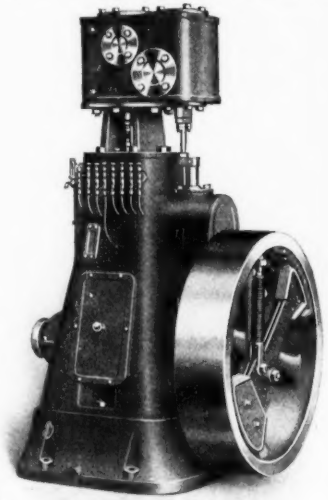
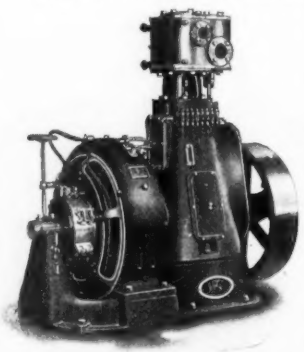


The RECIPROCATING parts are entirely enclosed within the oil and dust-proof frame, yet are readily accessible for adjustment.

LUBRICATION System is of the gravity type, automatic and positive. The oil flows from the reservoir in the top of the frame, through piping equipped with sight feeds, to all bearings. All oil not used flows to the reservoir in the base, is filtered through fine screens, and pumped back to the reservoir in the top of the frame. The engine may be run independently of the oil pump by filling the top reservoir through an opening provided in the frame and drawing off the excess oil from the bottom reservoir through a drain cock.

The CYLINDER is separated from the frame by a distance piece in which are the water-shed partition and main piston rod stuffing boxes. These are readily accessible while the engine is in operation.

REGULATION of the automatic type is most accurate. The variation between no-load and full-load is not over one and one-half per cent.



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OPERATION may be continuous at high speeds for long periods with very little attention.

ACCURATE BALANCE insures freedom from vibration.

MATERIAL AND WORKMANSHIP are the very best obtainable. Each part is subject to rigid inspection before being assembled, and the completed engine is given a rigid test and careful examination before shipping.

Write for Bulletin No. 171 describing the independent engine, or Bulletin No. 172 describing generating sets.

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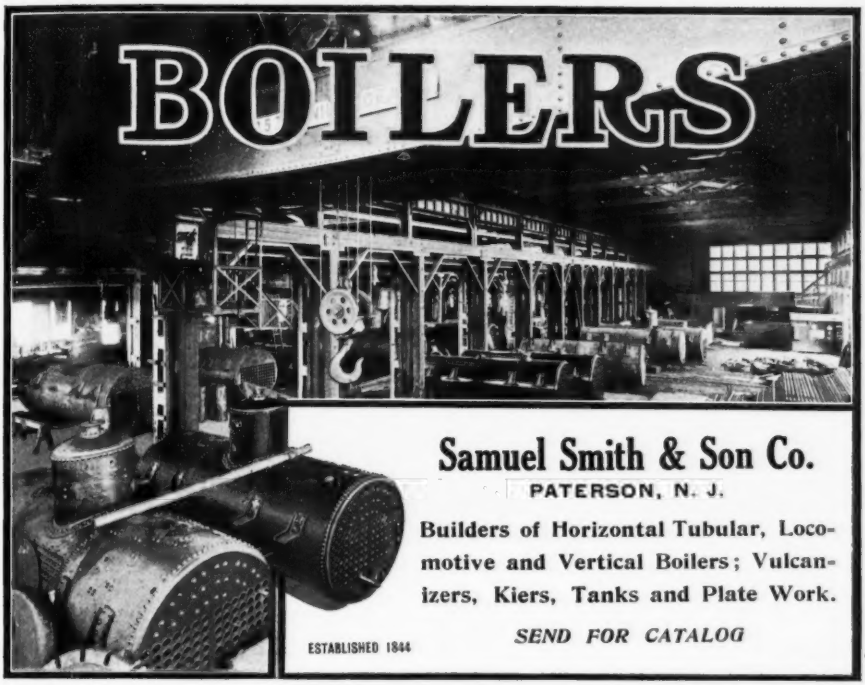

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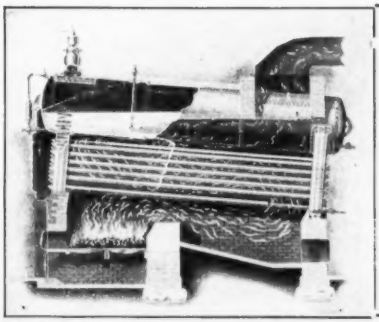

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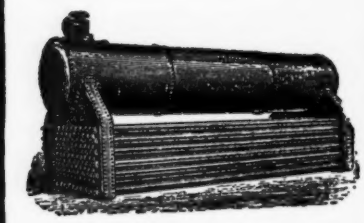

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The Otis Feed Water Heater, Oil Separator and Purifier

will be doing faithful duty when others are lying useless in the scrap heap. The peculiar deep construction of the separator at the bottom is a feature not found in other heaters. The OTIS combines all the elements necessary to deliver feed water to your boilers at a temperature of 210-212 degrees free from all oil, scale or grit, without back pressure. It requires no attention while in operation and can be cleaned easily and thoroughly in a very few minutes. Let us send you a catalogue telling **"what we guarantee** for the **OTIS** and reasons **why** we can make this guarantee."

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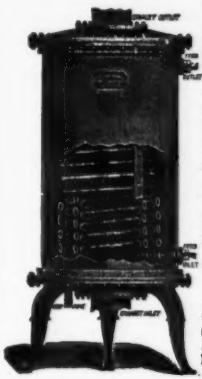

Its record: 205-212° F — 2,500-000 horse power in daily use in over 1000 stations.

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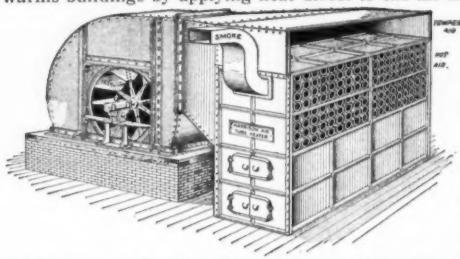
A Revolution in Heating Methods

As the gas engine develops power without steam or boiler, so the

HARRISON METHOD

warms buildings by applying heat direct to the air and distributing it by means of a fan. It eliminates the boiler, steam coils, traps, pumps, and piping



The Harrison Air Tube Heater

has an efficiency of 85 to 90 per cent. It resembles a sectional water-tube boiler except that, instead of water, air is heated in passing through the tubes. Designed especially for use with a fan.

The reasons for the high efficiency of the Harrison method are explained in our NEW ILLUSTRATED BOOKLET.

Harrison Engineering Co.

Boston 112 Water Street — 42 East 23d Street, NEW YORK — Chicago 1209 Fisher Bldg.

22-2

The Blake-Knowles Multi-Current Feed Water Heater,

VERTICAL or HORIZONTAL,

is designed on correct principles so as to obtain the highest efficiency by a rapid heat transference, with six passes for the feed water and three passes for the exhaust steam.

Send for Bulletin B-68

The Blake & Knowles Steam Pump Works

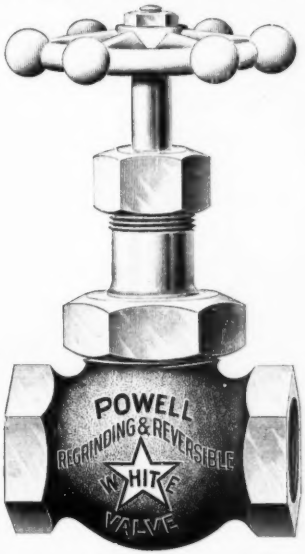
115 BROADWAY NEW YORK

Branch Offices in all Principal Cities

WORKS, EAST CAMBRIDGE, MASS.

THE POWELL WHITE STAR VALVE

Reversible Regrindable Renewable



The Reversible and Renewable Features alone make the Powell WHITE STAR Valve unusually valuable for all power service. When one side of the disc is worn out reverse it. When both sides of the disc are worn out throw the disc away and not the valve—you can buy a new disc, you don't need a new valve. This new disc can be inserted in the holder in ten minutes.

This feature is not possible with the ordinary regrinding valve, when the disc wears out you must throw the valve away.

The cost of a disc is a few cents.

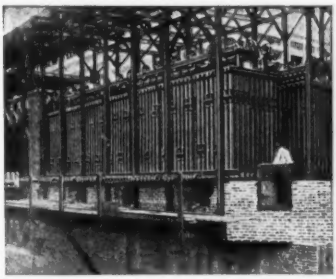
The cost of a new valve is dollars.

Figure the difference and see your advantage. All dealers have them or can get them for you. Look for WHITE STAR on the body.

THE WM POWELL CO.

DEPENDABLE ENGINEERING SPECIALTIES

CINCINNATI



$10,000,000 Saved BY Green Economizers

We recently made some calculations which show that the **Green Fuel Economizers** now in use in the United States are saving over $10,000,000 a year to their owners.

This saving is made up of several items:

1. The economizer actually saves 10 to 15% of the coal bill;

2. Due to smaller amount of coal used, there is less expense for handling coal and ash;

3. It increases the efficiency of boilers by preventing scale-forming material from going into them;

4. For a similar reason, boiler cleaning expenses are greatly reduced.

5. It introduces into the boilers hot instead of cold water that would produce undue strains in the shells and tubes.

Every day new plants are taking advantage of the money-saving properties of **Green Economizers.** Only improved construction is used, therefore cost of repair and maintenance is practically nil. Have you investigated the saving that one will give in your plant?

Write and tell us how many pounds of coal you burn in twenty-four hours, the temperature of flue-gases, and cost of coal and we will give you definite figures as to the amount of saving that a Green Fuel Economizer will effect in your plant.

Ask for Catalog "106 ER."

THE GREEN FUEL ECONOMIZER CO.

MATTEAWAN, N. Y.

New York City Boston Chicago Atlanta
San Francisco Los Angeles Seattle
Salt Lake City Montreal

Engineers; Builders of Green's Fuel Economizers, Fans, Blowers and Exhausters, Steam Air Heater Coils, Waste Heat Air Heaters, Mechanical Draft, Heating and Ventilating and Drying Apparatus, Draft Dampers and Engines.

ONEIDA
STEEL PULLEYS

Every ton weight on your shaft requires one horse power to revolve it at normal speed. Can you afford to use cast iron pulleys when the "ONEIDA" Steel Pulleys weigh but a third as much as pulleys for the same service?

The cast iron pulley grips the shaft at but one or two points by one or two set screws, that throw it out of balance. At every revolution of the pulley there is a severe strain upon the fastening, with a tendency to loosening the grip of it upon the shaft.

The "ONEIDA" grips the shaft from every direction, all around, insuring perfect running balance. It is easily and quickly erected upon the shaft and tightly held by compression bolts.

Send for catalogue.

Oneida Steel Pulley Company
ONEIDA, N. Y., U. S. A.

The American Steel Split Pulley was the *first* all-steel split pulley made. Only 12 years old and requires the largest pulley plant in the world to keep up with the demand. The "American" is on top because of its evident superiority.

THE AMERICAN
STEEL SPLIT PULLEY

is sold by supply houses throughout the world. If pulleys and power economy are part of your worry—get our descriptive circulars, catalog and prices.

THE AMERICAN PULLEY CO.
MAIN OFFICE & WORKS PHILADELPHIA, U.S.A.
Chicago Branch, 124 S. Clinton St.

Our **Reflex Water Gage** is the safest, most reliable and most practical gage on the market and can be applied to any boiler.

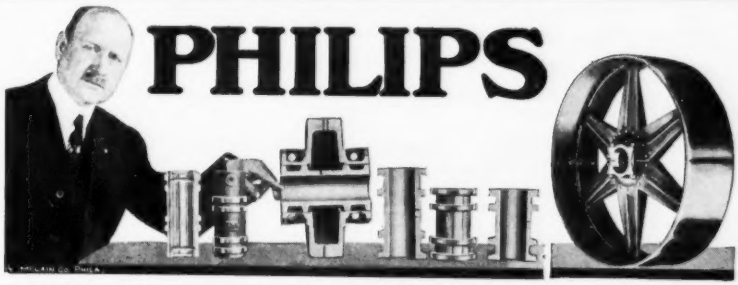
The Water Shows BLACK
—you can't fail to see it, even at a distance.

SEE →

No *squinting!* Read at sight. It is used by the world's greatest navies, is easy to mount and is safe and durable at high pressures.

We also manufacture a complete line of High Grade Water Gage Apparatus. Catalog on request.

JERGUSON MFG. CO.
Reflex Gage and Wiltbonco Fittings
221 Columbus Ave., Boston, Mass.



PHILIPS

Let Me Show You One Reason Why the Philips Solves Your Pulley Problem

Take just the bushings. They are lathe turned and bored true to insure perfect fit to shaft. See where I'm pointing?

Notice that you get a perfect surface for shaft grip across the entire width of the hub.

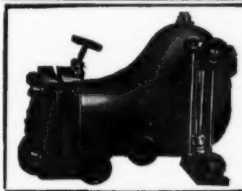
They can only be fitted one way, they're "fool proof." Study the set on the left nearest to me, notice the lubricating system.

One of the wells at the end is filled by an ordinary lubricating cup. The action of the pulley when revolving constantly circulates the lubricant through the grooves running from end to end, effecting a perfect and uniform lubrication.

There is an additional small well at each end of the bushing which prevents oil from running out on and dripping off the shaft. These bushings permit the pulleys being placed on different diameter shafts.

May we tell you the rest of the story, about the hub, the spider arms and on out to the perfect unbroken crown? Tear out this ad. and drop us a line.

Philips Pressed Steel Pulley Works, Philadelphia, Pa.



The McDaniel Improved Steam Trap

DISCHARGES CONTINUOUSLY AND NEVER BLOWS STEAM.
MADE EXTRA HEAVY FOR HIGH PRESSURE.

We also manufacture Reducing Valves, Exhaust Pipe Heads, Separators for Live and Exhaust Steam, Blow Off Valves, Relief Valves, Ejectors, Etc.

SEND FOR CATALOGUE.

WATSON & McDANIEL CO., 142 North 7th Street, PHILADELPHIA, PA.

WHEELER CONDENSER & ENGINEERING COMPANY

West St. Bldg., New York
Works: Carteret, N. J.

SURFACE, BAROMETRIC AND JET CONDENSER
"VOLZ" PATENT COMBINED SURFACE CONDENSER AND FEED WATER HEATER
FEED WATER HEATERS
"BARNARD-WHEELER" WATER COOLING TOWERS
EDWARDS AIR PUMP — CENTRIFUGAL PUMPS
ROTATIVE DRY VACUUM PUMPS — CATALOGS ON REQUEST
CHICAGO ATLANTA CINCINNATI SAN FRANCISCO LONDON YOKOHAMA TRIESTE PARIS

DART UNIONS

The Dart Union has *two* bronze metal seats, properly ground, which are *immune* from *corrosion*, and *heavy malleable pipe ends* and *nut*. Nothing more is needed.

E. M. DART MFG. CO. PROVIDENCE, R.I.

THE BUSY ENGINEER
will save time by reading the
ENGINEERING INDEX.

COOLING TOWERS

Fan and Natural Draft

GEORGE J. STOCKER
ST. LOUIS, MO.
WRITE FOR CATALOGUE

Please mention The Engineering Magazine when you write.

"DETROIT" IMPROVED STANDARD LUBRICATOR

The reputation of Detroit Lubricators has been built up solely on the simplicity of their design, coupled with their ability to live up to every claim we make for them in quality of material and workmanship and general all-round goodness.

They simply **cannot** fail to work.

A few of the many strong points that may be emphasized are:

They are easily attached and can be readily removed for repairs, etc., without letting down the steam.

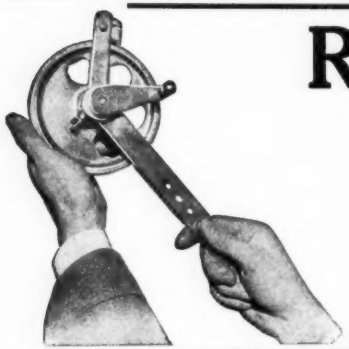
The support arms are placed in such position that vibration is reduced to a minimum. The oil is always kept in a thoroughly liquid condition by our arrangement of the heating passage.

The drain stem under the sight feed glass facilitates draining and cleaning the glass at any time.

The sight feed glass and valve regulating the feed are on the opposite side from the steam pipe.

The cut shows our Improved Standard Lubricator. Our Catalogue A 23 shows over 400 different styles, sizes and finishes of Sight Feed Lubricators. Wherever steam power is employed you will likely find a Detroit Lubricator. It's guaranteed.

DETROIT LUBRICATOR COMPANY. DETROIT, U. S. A.



ROCHESTER

Automatic Lubricators

can be so adjusted as to feed only one drop of oil for every three revolutions of the ratchet wheel, each of which contains 160 teeth. The pawl can be adjusted so that it will take but one tooth for every revolution of the engine. This means that, if necessary, as small an amount of oil as one drop can be fed for every 480 revolutions of the engine.

May we send you a Catalogue?

GREENE, TWEED & CO.

109 DUANE STREET NEW YORK

INCREASED

ECONOMY IN FUEL CONSUMPTION

IN BOILERS AND SUPERHEATERS

GUARANTEED BY **POTTER SEPARATOR CO.**

3 FRONT ST., NEWBURGH, N.Y.

FOOS

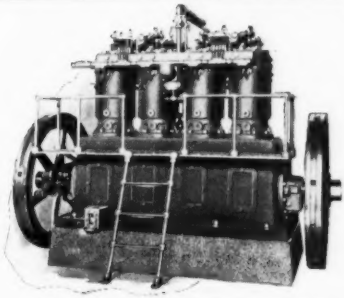
GASOLINE ENGINES

with patented wipe spark igniter, vertical valves, centerline counterbalance and large bearings, combined with ease of starting, operating and maintaining,

ARE THE RESULT OF TWENTY-TWO YEARS' EXPERIENCE

Engines for all purposes and all fuels. 2 to 500 Horse Power. Free book No. 44 tells why the Foos Engines should interest you.

THE FOOS GAS ENGINE CO., SPRINGFIELD, OHIO

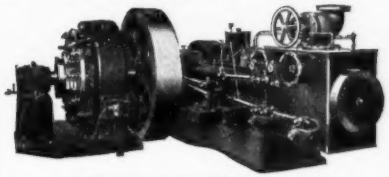


Reduce Your Manufacturing Costs

The Installation of the Bruce-Macbeth Gas Engine is the first step toward lowering manufacturing costs. A power unit which is Reliable, Safe and Positive in operation, developing evenly and continuously its full rated horse power on a minimum of fuel consumption. No ashes or smoke; takes up very little space; no blowouts, no leaky steam pipes or joints, or any of the innumerable repairs incident to a steam plant. Can be operated on Natural, Artificial or Producer Gas. Let our Catalogue show you the dollar saving road.

THE BRUCE-MACBETH ENGINE CO.
CLEVELAND, OHIO
2103 CENTER ST., N. W.

BALL ENGINES



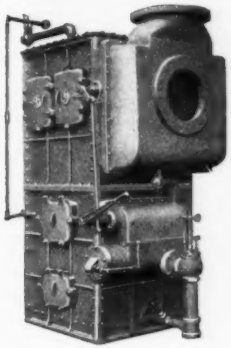
Is Economy an object to you?
Do you want an Engine that can always be depended on?

These most essential requisites in Engines for Electrical power service we are able to furnish. Write us for further information.

THE BALL ENGINE CO.
ERIE, PA.

ANTI-CORROSIVE CYLINDER OIL
MANUFACTURED ONLY BY E. W. KELLOGG & SON

WRITE FOR 90 DAY TRIAL PROPOSITION



Easy To Prove That The Cochrane Heater Pays For Itself.

Suppose that the water enters your boilers now at 160° F. and that the closed heaters are condensing all the exhaust steam available. Now by throwing out the closed heater, putting in a **Cochrane** heater, and saving the steam condensed in heating the water, you can raise the temperature at least ten degrees higher. Ten degrees is equivalent to a saving of 1% coal. 1% of coal for a 300 horse power boiler ten hours per day, 300 days per year, with coal costing three dollars per ton, is $50, or an absolutely sure saving of more than 20% annually on the cost of the heater.

And we have said nothing about keeping boilers in better shape. A **Cochrane** heater protects them from strains and from a large amount of scale-forming material. (If the water forms hard scale, install our **Hot Process System,** which in addition to doing the work of a **Cochrane** Heater provides for softening the water.)

If you are putting in a heating system, we can show you positively how you can save from $50 to $500 on the first cost of the equipment. Send us particulars and we will prove it.

HARRISON SAFETY BOILER WORKS
3138 N. 17TH ST. PHILADELPHIA, PA.

A postal card addressed to us, requesting one of our Folders, A-17, will bring you valuable information concerning the use of exhaust steam and its economical application through the medium of an

Austin Fig. "S"

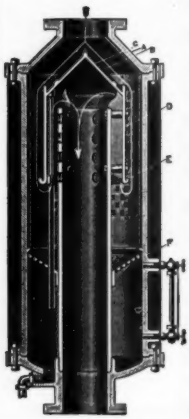
Special Oil Separator

Designed with great internal area, one casting, and many other distinct points of advantage, its use insures the perfect separation of all oil and impurities from the steam, rendering the condensation distilled water. We ship on trial. Send for Catalog A-17.

AUSTIN SEPARATOR COMPANY

26 WOODBRIDGE ST., DETROIT, MICH.

SWEETS SEPARATORS



¶ It is not what we say, but what Sweets Separators do, that has sold nearly *6,000* of them in *13* years, and put them in the 99 per cent. class.

¶ **SWEETS SEPARATORS** deliver live steam 99½ per cent. dry, and take out 99 per cent. of the oil in exhaust steam.

¶ All styles and sizes —all guaranteed.

¶ Send for catalog.

DIRECT SEPARATOR CO.

218 Geddes Street SYRACUSE, N. Y.

THE ONLY ONE

All Separators have their merits. But the

Stratton Separator

is *the only one* that will take care of a large influx of water, positively separate it from the steam, and keep it separated, and so long as the drain pipe is open no water will be again picked up and carried to the engine. That involves considerably larger proportions and higher first cost. But it is a wise investment—you get your money back over and over again.

"Dry Steam" is the title of our new pamphlet—written by a distinguished engineer—worth money to every intelligent reader. Free to all parts of the world on request.

GOUBERT MFG. COMPANY

90 West Street, - New York, U. S. A.

HARBISON-WALKER REFRACTORIES CO
PITTSBURG, PA.

Highest Standard of Quality

Importers Magnesite and Chrome Ore

FIRE CLAY
SILICA
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Blast Furnace Linings

Blast Furnace Stove and Piping Brick

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Rolling Mill and Heating Furnace Brick
Open Hearth Furnace Refractories
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Brick and Shapes for By-Product and Beehive Coke Ovens, Gas Plants, Gas Producers, etc.

PROMPT SHIPMENTS **LARGEST CAPACITY**

HERAEUS LE CHATELIER PYROMETER

For absolute control of all kinds of heat —measurements up to 1,600 deg. Celsius or 2,920 degrees Fahrenheit. EXACT, DURABLE, Easy to Understand and to Handle.

HERAEUS PATENTED ELECTRICAL FURNACES for LABORATORY AND EXPERIMENTAL USE.
FUSED SILICA WARE OF EVERY DESCRIPTION AT MODERATE PRICES.
HERAEUS PATENTED FUSED QUARTZ GLASS ARTICLES OF EVERY DESCRIPTION.

This Heraeus Patented Fused Quartz Glass is not affected by any changes of temperature, whatsoever, and the coefficient of expansion is only 1-17 that of platinum.

It is of the utmost importance for all purposes where the above qualities are essential.

Write for information.

Pamphlets and References on application.

CHARLES ENGELHARD
Hudson Terminal Building
30 Church St. New York

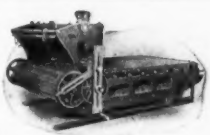
IF IT'S FOR YOUR FOUNDRY WE HAVE IT

For the past thirty-five years we have been manufacturing and selling Foundry Facings Supplies and Equipment. Thirty-five years' success in one line is pretty good proof that the goods are right.

Everything from a Flask-Pin to a Cupola

Whenever you want anything for your foundry write us. No matter what it is we have it. You will find our 370-page catalog showing "Everything you need in your foundry" a handy book to have close at hand. A copy is yours—free—for the asking. Simply write us for Catalog No. 40-H.

The S. OBERMAYER CO.
"Everything You Need in Your Foundry"
Cincinnati Chicago Pittsburgh



Green Chain Grate Stokers

Highest Capacity Automatic Labor-Saving
Highest Efficiency Smokeless Cheap Fuel

GREEN ENGINEERING CO.
115 Adams Street, Chicago
PITTSBURGH—ST. LOUIS—ST. PAUL

MANUFACTURERS

can increase dividends in no easier way than by reducing operating expenses.

Hard Water increases fuel costs, repair costs, loss from shut downs, etc., and an abundant supply of pure soft water would effect a real economy in any manufacturing plant.

A TYPE "K"

KENNICOTT

Water Softener would insure the soft water supply.

When writing, ask for **Type "K" Katalog.**

We should be pleased to make an analysis of the feed water you are now using at no expense to you.

Kennicott Water Softener Company

Chicago Heights, Illinois, U. S. A.

Kerr Steam Turbines

ARE BUILT AS PIANOS ARE,

"Grand, Square and Upright"

DRIVE

Generators, Pumps, Blowers

(direct and belt connected)

Send for Bulletin No. 8.

KERR TURBINE CO.

WELLSVILLE, N. Y.

WE-FU-GO

WATER SOFTENING AND PURIFYING SYSTEMS

SEND FOR OUR NEW CATALOGUE

FILTERS AND FILTERING SYSTEMS

SCAIFE

WM. B. SCAIFE & SONS CO. (FOUNDED 1802) PITTSBURG, PA.

Booth Water Softener

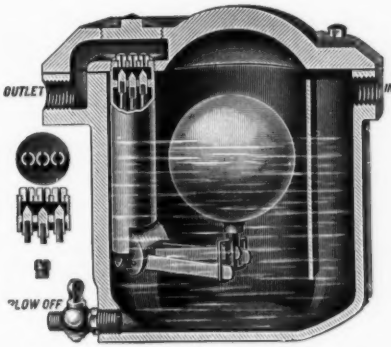
Send for new Catalog

L. M. BOOTH CO., 136 Liberty St., New York

CHICAGO Fisher Building

The Great Time Saver

THE ENGINEERING INDEX published in this Magazine is the greatest time saver ever put before the Engineering world. Thousands use it regularly—some do not. Have you looked into it? The Index is all you need to keep up to the latest developments in applied engineering. See the ENGINEERING INDEX in this Magazine.



With THREE VALVES it stands to reason this trap will discharge a greater amount of water under high pressure than any one valve trap.

THREE TRAPS IN ONE

The Wright
Emergency
High Pressure
Continual Flow

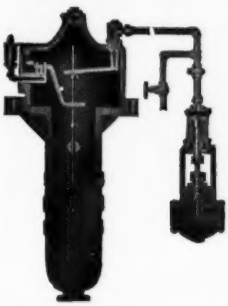
STEAM TRAP

SEND FOR OUR BOOKLET C-60. IT'S FREE

Keeps the steam line free of condensation, thus permitting a free circulation of DRY STEAM with all its efficiency and economy as compared with the bad service and waste incidental to wet steam.

Wright Manufacturing Co.

Detroit, Mich. - - 70 Woodbridge Street



CHEAPER FUEL AT ONCE

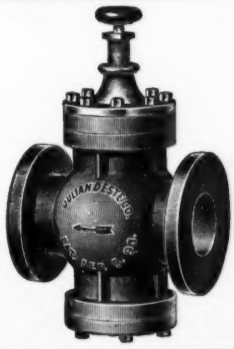
By immediately installing the **Gould Feed Water Regulator** you can greatly reduce your fuel cost. The bleed valve regulates the water-line to any level and **holds** it.

No burned or flooded boilers, no excessive fuel waste.

Every feature of the **Gould Regulator** is simple, durable and absolutely reliable.

Write for descriptive booklet.

THE SAFETY EQUIPMENT MFG. CO.
POWER PLANT SPECIALISTS
CHICAGO, ILL.



IMPROVED

Steam Pressure Regulator

One of the Curtis Specialties; containing a novel combination of old and well-established principles. Very simple and sensitive, compact and self-contained; without lever, weights or projections. It has no glands or packing; no dripping or leaking of steam or water. Suitable *for any* boiler pressure, and will deliver *accurately* any lower pressure from one to within a few pounds of the initial pressure. Send for Catalogue and learn more of this money saver.

JULIAN D'ESTE COMPANY
24 CANAL ST., BOSTON, MASS.

Please mention The Engineering Magazine when you write.

Fort Wayne Alternators
In Actual Service

These three multiphase machines have been in operation in the plant of one of the largest Railroad Companies in the country, for over four years and have more than fulfilled our guarantees.

We have made some seemingly large claims about the design, construction, reliability, etc. of our alternators, but the machines

"MAKE GOOD" EVERY TIME

You had better consider this point when you are in the market for an alternator.

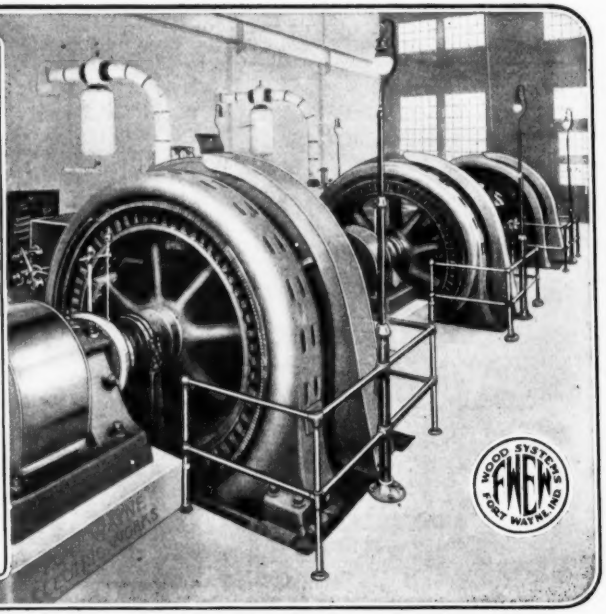
You can't afford to experiment with those that look good in theory alone, when it costs no more to get one with a record of success and a reliable company back of it.

We want to send you our Bulletin R1109 which explains the superior points of our alternators

Are you not interested enough to send us a card?

Fort Wayne Electric Works

Fort Wayne, Indiana



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IRON OR STEEL

FOR
ELECTRIC RAILWAYS
ELECTRIC LIGHTING CO'S
SIGNAL, TELEPHONE, TELEGRAPH SERVICE
TRANSMISSION LINES AND CATENARY SUSPENSION LINES

ELECTRIC RAILWAY EQUIPMENT CO.
General Office: CINCINNATI, O. U.S.A.
Shops: READING PA. · WHEELING W.VA.

MANUFACTURERS OF HARD AND FLEXIBLE FIBRE
FOR ELECTRICAL INSULATION AND MECHANICAL PURPOSES
DIAMOND STATE FIBRE COMPANY
ELSMERE U.S.A. DELAWARE
MADE IN SHEETS, RODS, TUBES, WASHERS DISCS AND SPECIAL SHAPES
COLORS RED, GREY AND BLACK. WRITE FOR ESTIMATES

SIMPLEX QUALITY
Speaks For Itself
Write for Booklet "C"

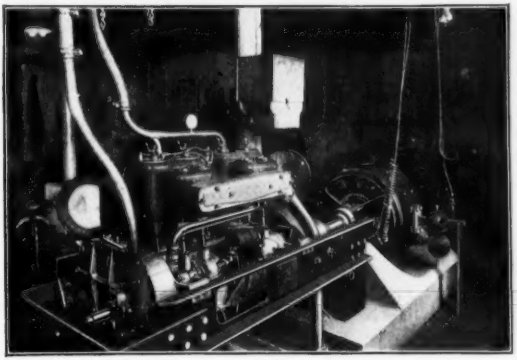
Electric Heating Goods
Enamel Rheostats
Resistance Units
With a Reputation
SIMPLEX ELECTRIC HEATING COMPANY
Cambridge, Mass.
Monadnock Block, Chicago
612 Howard St. S. Francisco

$125

were saved by one user of THE ENGINEERING INDEX in one order. Does it save you money too?

ENGINE TESTING

Ask us for our Bulletin No. 1087 which explains how you can test any kind of engine with a Sprague Electric Dynamometer.



Sprague Electric Dynamometer Testing Engine.

Quick and Accurate Results

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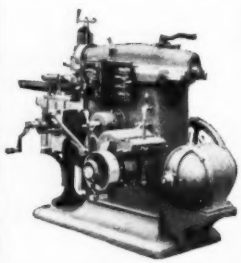

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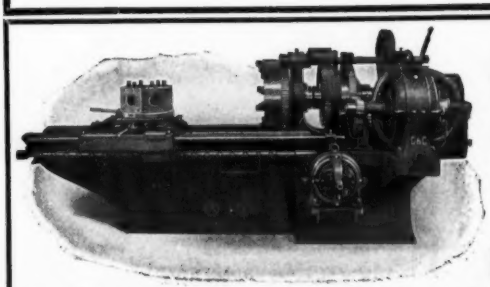

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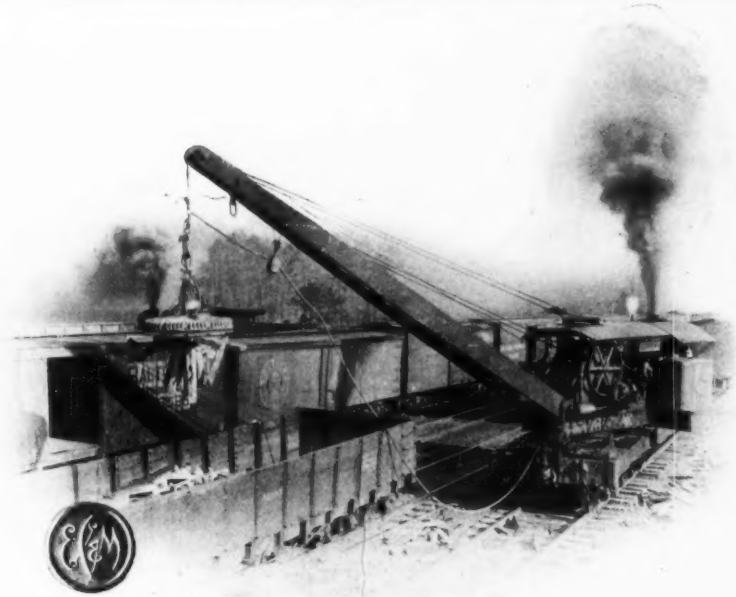

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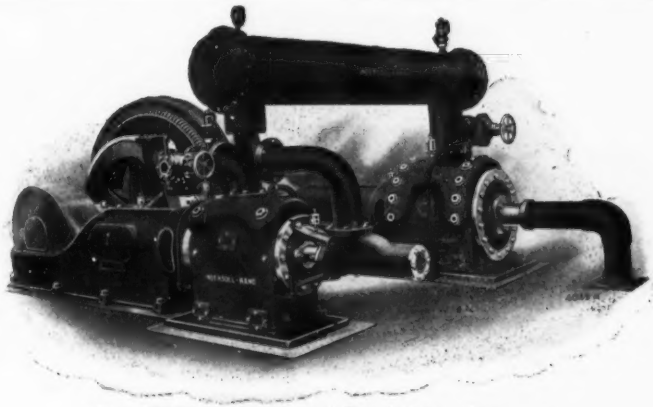

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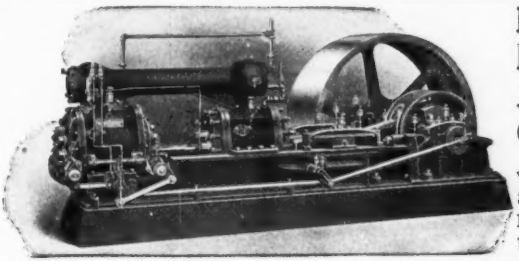

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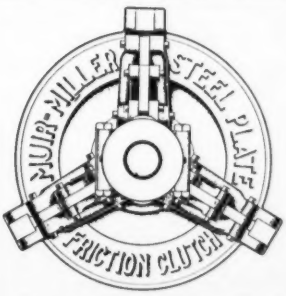

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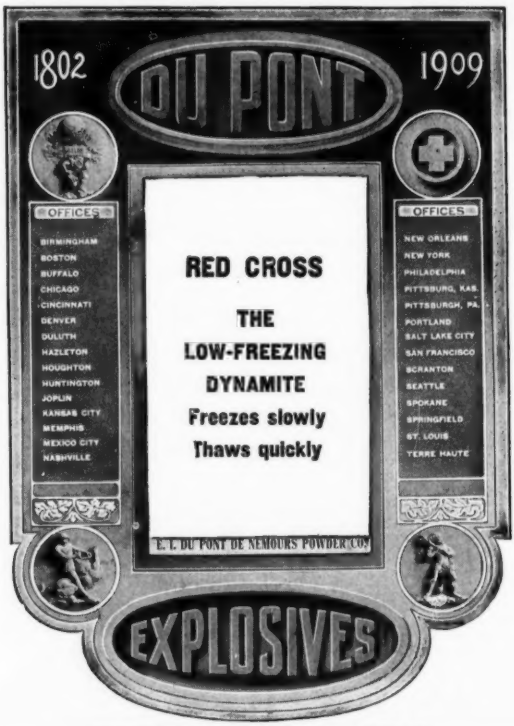

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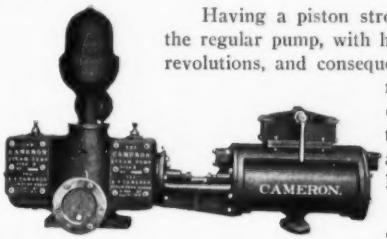

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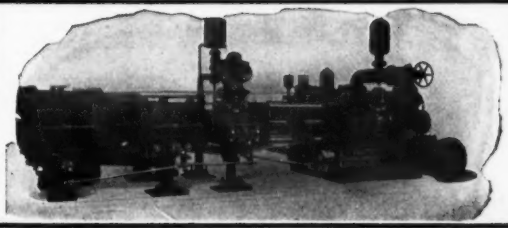

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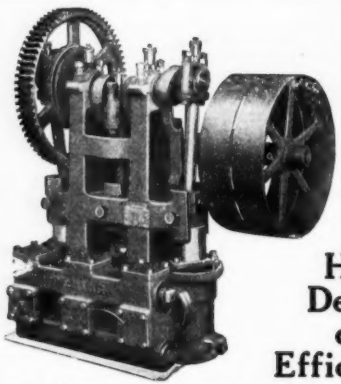

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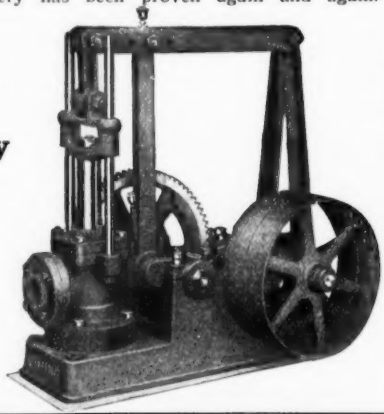

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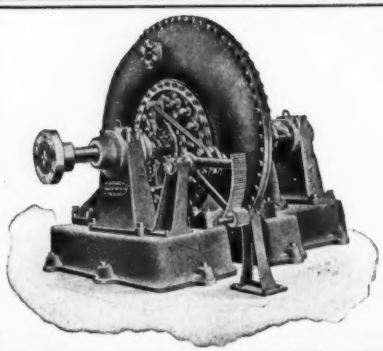

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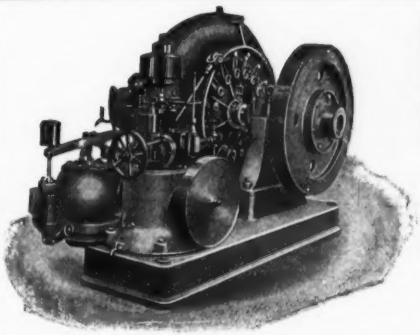

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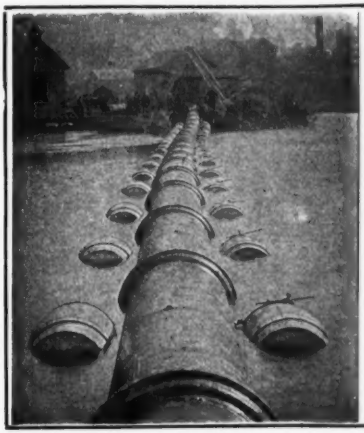

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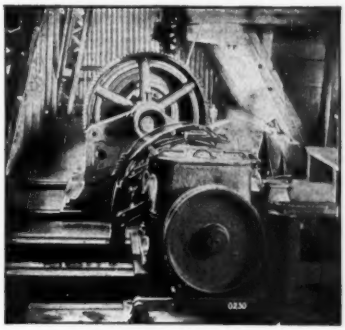

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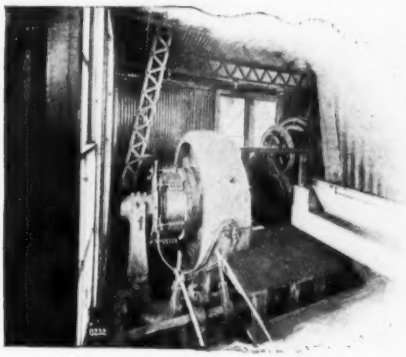

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ELECTRIC HOIST EQUIPMENT IN A POWER STATION.

These hoists are fitted with gear cases that enables them to stand any test of exposure to weather, dust or ashes.

They are simple and rugged in construction and every hoist we send out is guaranteed to do the work for which it is sold.

The Gears have Machine-Cut Teeth and all Parts are Interchangeable

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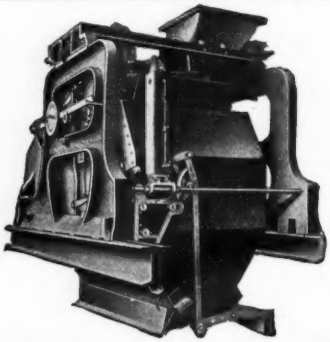

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Invaluable for checking coal consumption of boilers—saves carelessness in firing.

A cheap and efficient means of checking bills for coal received at power station, factory or hotel. Absolutely prevents overcharge or theft.

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Satisfactory operation under the most trying conditions of service is assured.

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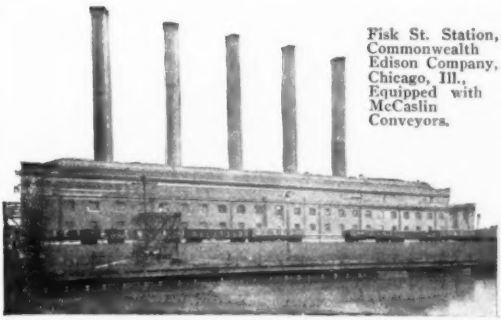

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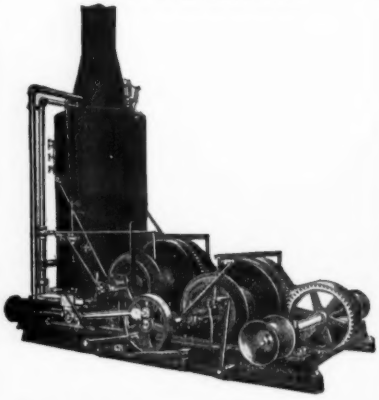

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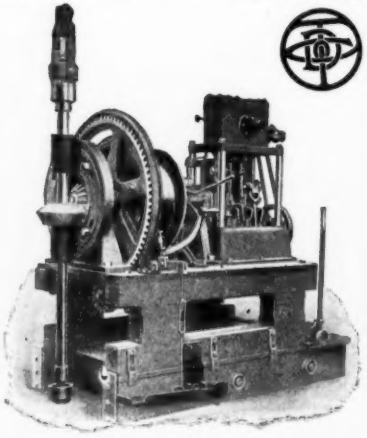
Let us tell you what they are doing



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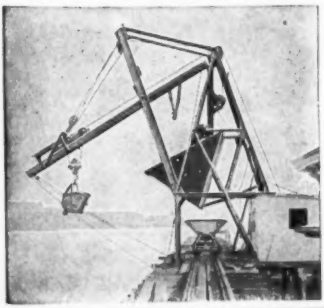

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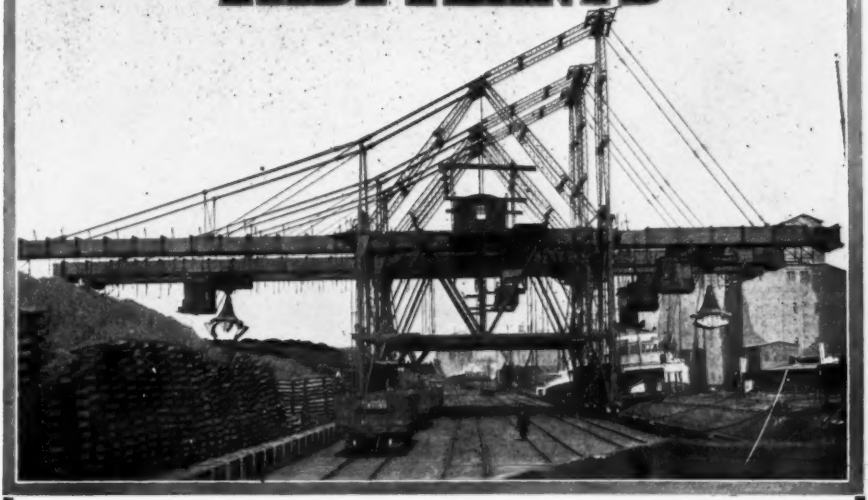

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Installed for the New York Central R. R. Co., Buffalo, N. Y., is giving Excellent satisfaction, and we would like to know your requirements in the hoisting line, so that we may figure with you as to what is best for you. Write us for 5196.

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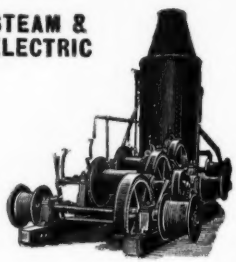

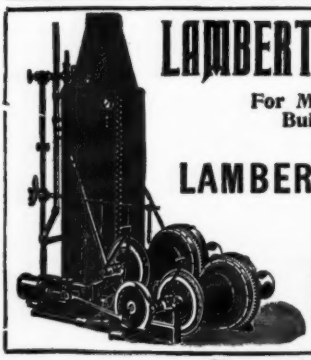

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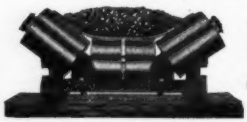

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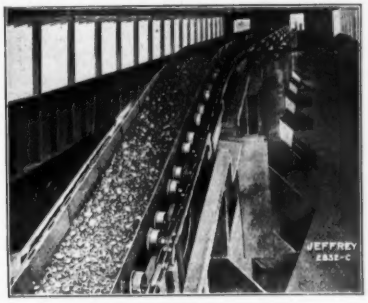

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for handling coal, stone, ores, sand, gravel and package materials of all kinds.

We build coal and ashes handling systems for power plants, elevators, screens, crushers, complete coal mine equipments.

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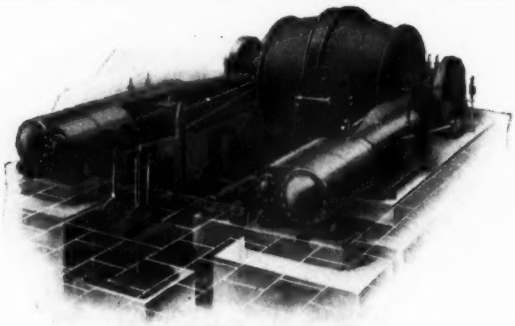

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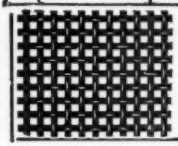

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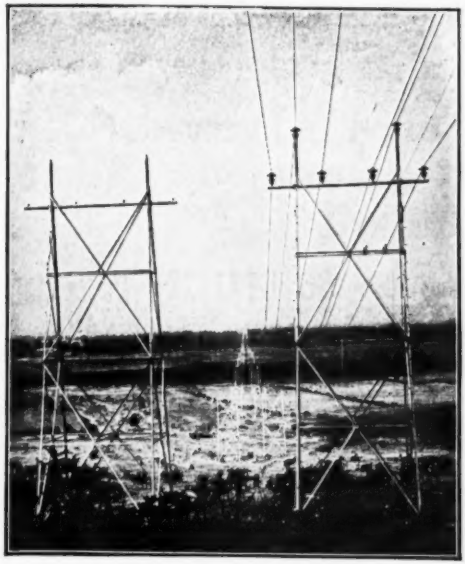

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A Story of an Industry

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CORPORATIONS have ambitions just as men have. And they have set-backs and disappointments too; very human ones.

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So the story of the struggle of a corporation toward an Ideal is full of human interest bordering on the dramatic.

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So MUCH better that the name "Inland" on a sheet would stand for something distinctly above and beyond the ordinary.

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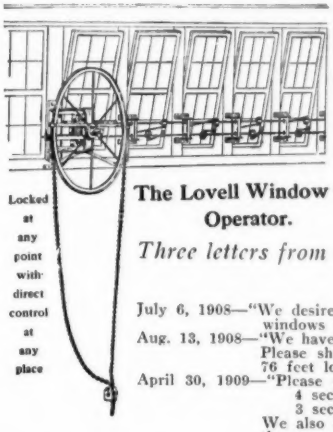

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IN YOUR SHOP
sash can be controlled with the
LOVELL WINDOW OPERATOR
just as easily

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We also desire to add that we have been very much pleased with the apparatus which you furnished."

May we furnish you with details and prices?

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Sash Operating Apparatus

Lord & Burnham Co.
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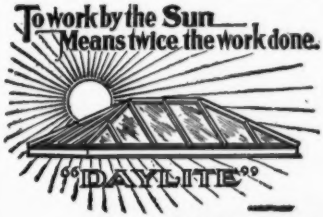

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Van Noorden Skylights

make Daylight possible over large floor areas.—*Ask for Catalogue "C."*

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CORCORAN TANKS

CORCORAN TANKS have always been, and will always be, made of the best material. We will not risk the reputation built up in the past forty years by using inferior material, or by inefficient workmanship. The name "Corcoran" on a tank is a guarantee that only the **best** material, built by **"Corcoran"** workmen, using **"Corcoran" special machinery,** is employed in its construction.

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Our Catalogue gives reasons why.

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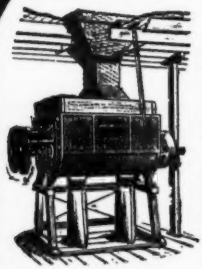

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Also used in the manufacture of cement, wall plaster and all intimate mixtures.

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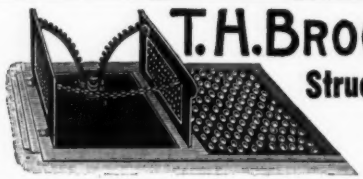
Fire Brick stamped Henry Maurer, No. 1, are Standard; with such, and good quality Fireclay, satisfactory results follow.



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Doors, Window Frames, Sash and Trim
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40-inch Die 24-inch Roll

15,000 lbs. Crushing Effect

Will take Portland Cement clinker 1½ inches diameter from the kiln and deliver a finished product.

85 to 87% through 200 mesh screen.
13 to 15 bbls. per hour.
50 to 55 horsepower.
Limestone, 5 to 8 tons per hour.
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Other materials in proportion.

It saves cost in buildings.
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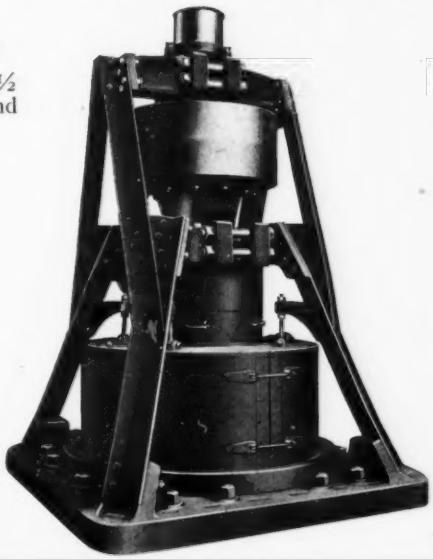

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"The Perfect"

These Screens are the result of Years of Experience and Expenditure of Money

Users testify to their Worth.

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DOUBLE CRIMPED WIRE SCREENS

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The kind that guarantees the positive holding of all your fixtures.

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hold where other means of securing work loose and drop out.

We've a catalogue and free samples for you. Ask for number **56**

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THAT we offer you the services of skilled mechanics and half-a-million-dollar-plant, built and equipped especially to make hollow metal doors and trim, under our original patents?

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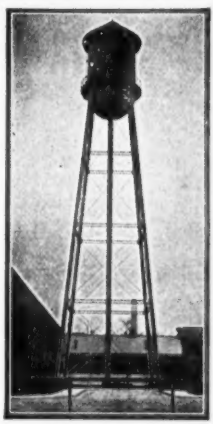

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For Railroads, Factories and Towns

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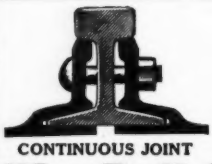

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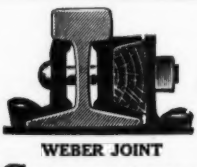

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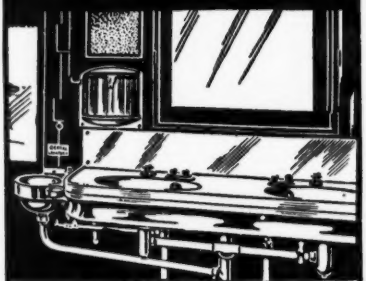

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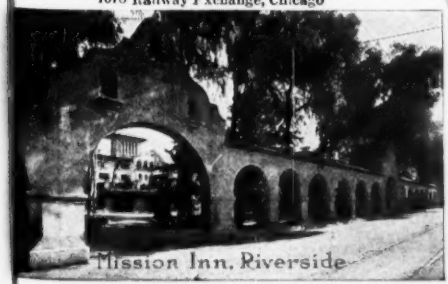
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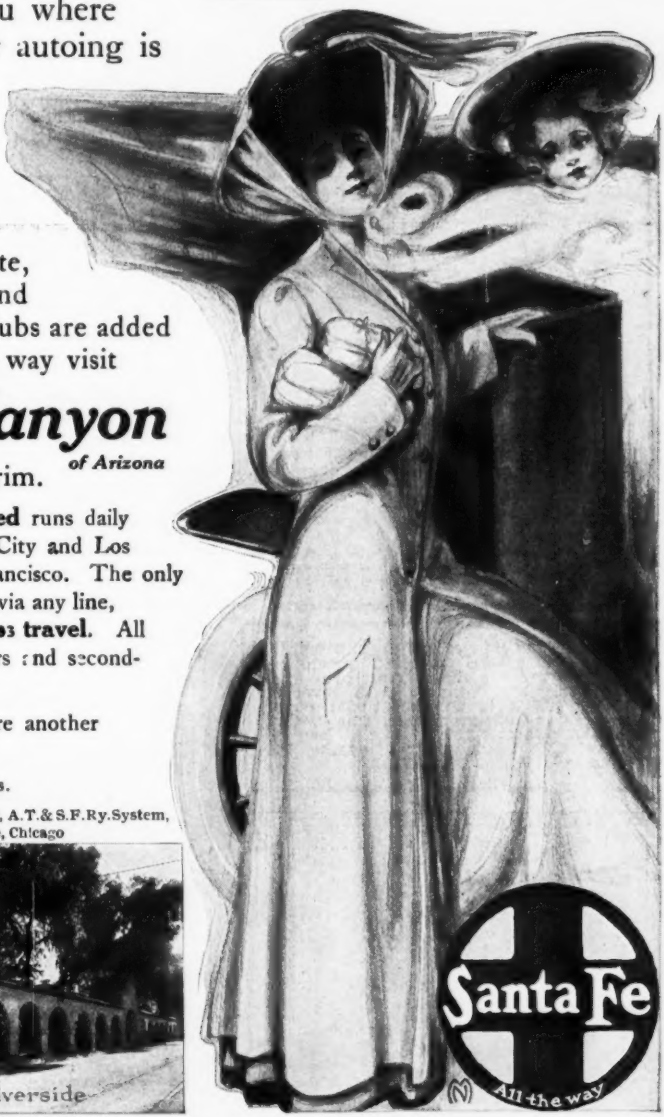

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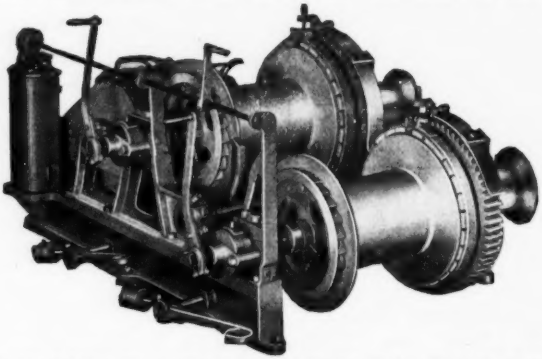

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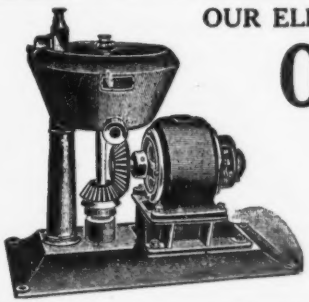

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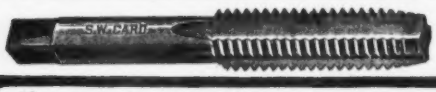

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(Subject XVI. for Discussion at the Eighth Session of the Railway Congress). J. M. Culp. Discusses suitable measures for developing traffic in perishables. 28900 w. Bul Int Ry Cong—Dec., 1909. No. 11263 G.

MISCELLANY.

Belgium.

Transportation and Traffic in Belgium. Logan G. McPherson. Describes the conditions and requirements, the waterways and railways, discussing traffic statistics, rates, etc. 3500 w. Ry Age Gaz—Jan. 28, 1910. No. 11305.

Canada.

The Railway Situation in Canada. J. L. Payne. A detailed account of the development and present situation, showing progress, strength and a promising outlook. 3000 w. Ry Age Gaz—Jan. 14, 1910. No. 10883.

China.

Internal Communication in China. Editorial on the remarkable change in the attitude of China toward modern progress, and discussing the need of internal communication and the new regular service on the Upper Yangtse Kiang. 1800 w. Engng—Jan. 14, 1910. No. 11125 A.

Finance.

Dividend Changes and New Railway Securities in 1909. Gives tables showing the changes and new securities which reflect the improved earnings, with comments. 3000 w. R R Age Gaz—Dec. 29, 1909. No. 10553.

Germany.

Transportation and Traffic in Germany. Logan C. McPherson. The present number is mainly a historical review of the development. 3000 w. Ry Age Gaz—Jan. 14, 1910. Serial. 1st part. No. 10882.

Java.

Steam Tramways in Java (Die Dampftrambahnen auf Java). A brief general review of railway development in Java. 2300 w. Glasers Ann—Dec. 15, 1909. No. 11088 D.

Mexico.

Government Railway Control in Mexico. E. H. Talbot. Explanation of the purpose of the Mexican Government in adopting the policy of national control of its railway system, and information related. Map. 2000 w. Ry Age Gaz—Jan. 28, 1910. No. 11306.

Narrow-Gauge.

The Difficulties of Effecting Junctions and Exchanging Rolling Stock on Metre-Gauge Railways (Note sur les Difficultés de Raccordement et d'Echange du Matériel entre les Chemins de Fer à Voie de 1 Mètre). M. Pellarin. A consideration of European railways of local interest. Ills. 8800 w. Ann d Ponts et Chaussées —1909-VI. No. 11078 E + F.

Norway.

The Bergen and Christiana Railway. An illustrated description of this new railway through the most mountainous region in Norway, where great natural difficulties had to be overcome. Map. 5000 w. Engng —Dec. 24, 1909. No. 10640 A.

Railway Securities.

Regulation of the Issuance and Ownership of Railway Securities. Editorial discussion of the part of Pres. Taft's recent message regarding regulation of railways and trusts. 2000 w. Ry Age Gaz—Jan. 21, 1910. No. 10949.

Reviews of 1909.

Railways and Tramways. Begins a review of progress during 1909. The present number briefly considers the United Kingdom, Continental Europe, and Greater Britain. Ills. 4000 w. Engr, Lond—Jan. 7, 1910. Serial. 1st part. No. 10918 A.

Review of 1909 Annual Reports. Ray Morris. Shows the prevailing tendencies of the railway year by means of graphic analysis. 1500 w. R R Age Gaz—Dec. 31, 1909. No. 10552.

Review of 1909. Editorial on the progress of American railways during the year. 2500 w. R R Age Gaz—Dec. 31, 1909. No. 10551.

Simplon.

The Franco-Swiss Convention on the Lines of Access to the Simplon Tunnel (La Convention Franco-Suisse sur les Voies d'Accès au Simplon). A Lebrun. A discussion of the Alpine railway situation. Ills. 2600 w. Génie Civil—Dec. 11, 1909. No. 11032 D.

South America.

Buenos Ayres & Pacific. Map and brief description of lines between Buenos Ayres and Mendosa. 800 w. Ry Age Gaz —Jan. 28, 1910. No. 11301.

Statistics.

On the Question of Statistics (Subject XIV for Discussion at the Eighth Session of the Railway Congress). Thomas R. Price. Considers principles of statistics of railways in operation. 18400 w. Bul Int Ry Cong—Dec., 1909. No. 11262 G.

United States.

Railroad Work South and Southwest. Samuel G. Wilmer. Reviews what has been accomplished in the recent past, and the future prospects. 2500 w. Mfrs' Rec —Jan. 6, 1910. (Special No.) No. 10679 C.

Valuation.

Original Cost and Cost of Reproduction of the Northern Pacific Railway (1645 miles) in the State of Washington. Data as determined by Halbert P. Gillette, and given as testimony at the hearings before the Railroad Commission. 3500 w. Engng-Con—Jan. 12, 1910. No. 10824.

We supply copies of these articles. See page 970.

STREET AND ELECTRIC RAILWAYS.

Car Barns.

New Car House of the Capital Traction Company, Washington, D. C. Illustrated detailed description. 1500 w. Elec Ry Jour—Jan. 8, 1910. No. 10654.

Cars.

Large Cars Built by the Key Route, Oakland, Cal. Illustrated description of cars having an extreme length of 70 ft. over couplers. 1000 w. Elec Ry Jour—Jan. 15, 1910. No. 10858.

Controllers.

Point Controllers for Electric Tramways. J. P. Tierney. Abstract of a paper read before the Inst. of Elec. Engrs. Reviews the development and describes the latest form of the Tierney-Malone point controller. Ills. 4500 w. Elec Engr, Lond—Dec. 31, 1909. No. 10778 A.

An Improved Type of Point Controller for Electric Tramways. J. P. Tierney. Describes the early forms and the present design of the "Tierney-Malone" point controller. Ills. 2500 w. Elect'n, Lond—Dec. 24, 1909. No. 10635 A.

Direct Current.

A 2750-Volt Direct Current System. A. H. Barringer. Read before the Can. Soc. of Civ. Engrs. Describes a system installed at Twickenham, near London, reporting concerning the difficulties encountered in operation. 2500 w. Elec Engr, Lond—Dec. 31, 1909. No. 10779 A.

Economics.

The Proper Treatment of Electric Railway Properties. J. McMillan. Gives details of costs and rates. 2500 w. Elec Ry Jour—Jan. 1, 1910. No. 10527.

Electric Traction.

The Equipment and Working Results of the Mersey Railway under Steam and under Electric Traction. Joshua Shaw. 6000 w. Elec Age—Jan., 1910. No. 11308.

Elevated Railways.

Forest Hills Terminal of the Boston Elevated Railway. John Ware. Illustrates and describes the concrete construction. 2200 w. Harvard Engng Jour—Jan., 1910. No. 11149 D.

Great Northern.

See Three Phase, under STREET AND ELECTRIC RAILWAYS.

Interurban.

Important New Work of the Illinois Traction System. Illustrates and describes the construction of McKinley bridge, a terminal in St. Louis, re-equipment of 100 miles of single-phase railroad for operation with d. c., new cars, repair shop extension, etc. 5000 w. Elec Ry Jour—Jan. 22, 1910. No. 10927.

Monorail.

The Scherl Gyroscopic Monorail Car. Illustrates and describes the principle of its operation. 1500 w. Sci Am—Jan. 22, 1910. No. 10958.

Operation.

The Methods Employed for Working Electric Railways. E. C. Zehme. Abstract from a book edited by Ludwig von Stockert. Ills. 11500 w. Bul Int Ry Cong—Dec., 1909. No. 11265 G.

Power Stations.

See Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Rails.

The Design of Tramway Rails, and Rail Wear. Robert B. Holt. Aims to show that the present design of tramway rails is at fault, and responsible for much of the unnecessary wear. Ills. 2000 w. Tram & Ry Wld—Jan. 6, 1910. No. 10923 B.

Reviews of 1909.

See same title, under RAILWAY ENGINEERING, MISCELLANY.

Subways.

See Tunnels, under CIVIL ENGINEERING, CONSTRUCTION.

Subway Signaling.

Signal System of the Hudson & Manhattan R. R. John Leisenring. Illustrated description of the signaling in the down town tunnels of the H. & M. R. R. (2d part.) 4500 w. Sig Engr—Jan., 1910. No. 10997.

Subway Terminals.

A Terminal Station. J. Vipond Davies and J. Hollis Wells. Read before the A. I. A., at Washington, D. C. A statement of conditions at New York City, the causes that led to the construction of tunnels under the rivers, and the selection of location and construction of the Hudson terminal buildings. Ills. 8500 w. Am Archt—Jan. 19, 1910. No. 10934 C.

Three Phase.

Discussion on "The Electric System of the Great Northern Railway Company at Cascade Tunnel." New York, Nov. 12, 1909. Also at Minnesota section, Nov. 18, 1909. 14000 w. Pro Am Inst of Elec Engrs—Jan., 1910. No. 11250 F.

Valuation.

Official Valuations of Private Property. Frederick W. Whitridge. Abstract of an address before the Am. Economic Assn., N. Y. Discusses methods of valuation. 3000 w. Elec Ry Jour—Jan. 15, 1910. No. 10859.

We supply copies of these articles. See page 970.

EXPLANATORY NOTE—THE ENGINEERING INDEX

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Applied Science. *m.* Toronto, Ont.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin du Lab. d'Essais. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Clay Record. *s-m.* Chicago.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.

Consular Reports. *m.* Washington.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giesserei-Zeitung. *s-m.* Berlin.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial Engineering. *m.* Pittsburg.
Industrial World. *w.* Pittsburg.
.ngegneria Ferroviaria. *s-m.* Rome.
ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. Ind. & Engng. Chem. *m.* Easton, Pa.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista Tech. Ind. *m.* Barcelona.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—*Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to* THE ENGINEERING MAGAZINE.

Ein neues Schnellbahn-System. By August Scherl. Size, 11 by 14 in.; pp., 122. Ills. Berlin: August Scherl.

Who's Who in Mining and Metallurgy, 1908. Size, 8 by 5½ in.; pp., 194. Ills. London: The Mining Journal.

Audel's Gas Engine Manual. Size, 8½ by 5½ in.; pp., xxiv, 469. Ills. Price, $2. New York: Theo. Audel & Co.

Soudure Autogène et Aluminothermie. By E. Chatelain. Size, 7 by 4½ in.; pp., x, 177. Ills. Price, 3 fr. 50 c. Paris: Gauthier-Villars.

Asphalts, their Sources and Utilization. By T. Hugh Boorman. Size, 9½ by 6½ in.; pp., 168. Ills. Price, $3. New York: William T. Comstock.

Notes on Hydro-Electric Developments. By Preston Player. Size, 7½ by 5 in.; pp., 68. Ills. Price, $1. New York: McGraw Publishing Company.

The Refrigeration Engineer's Pocket Manual. By Oswald Gueth. Size, 7½ by 4½ in.; pp., 156. Ills. New York: Published by the Author.

Laboratory Experiments in Metallurgy. By Albert Sauveur and H. M. Boylston. Size, 10 by 8 in.; pp., 73. Ills. Cambridge, Mass.: Published by the Authors.

The Essentials of Lettering. By Thomas E. French and Robert Meiklejohn. Size, 6½ by 9 in.; pp., 72. Ills. Price $1. Columbus, O.: Varsity Supply Company.

Die Entwicklung der deutschen Eisenindustrie in den letzten Jahren. By F. Wüst. Size, 11 by 7½ in.; pp., 33. Ills. Price, M. 1.50. Halle a. S.: Wilhelm Knapp.

Drawing Instruments, their Use and Abuse. By Walter G. Stephan. Size, 7½ by 5 in.; pp., 111. Ills. Price, $1. New York: McGraw Publishing Company.

Rocks and Rock Minerals. By Louis V. Pirsson. Size, 7½ by 5 in.; pp., 414. Ills., 110. Price, $2.50, 10/6. New York: John Wiley & Sons; London: Chapman & Hall.

Zur Frage der Erziehung der Architekten und Ingenieure zu Verwaltungsbeamten. By Friedrich Ritzmann. Size, 8½ by 5½ in.; pp., 50. Price, M. 1. Berlin: Julius Springer.

The American Practice of Gas Piping and Gas Lighting in Buildings. By Wm. Paul Gerhard. Size, 9 by 6 in.; pp., 306. Ills. Price, $3. New York: McGraw Publishing Company.

Telephone Law; the Organization and Operation of Telephone Companies. By A. H. McMillan. Size, 8½ by 6 in.; pp., xiv, 321. Price, $3. New York: McGraw Publishing Company.

Bricklaying System. By Frank B. Gilbreth. Size, 9 by 6 in.; pp., xi, 321. Ills. Price, $3. New York and Chicago: The Myron C. Clark Publishing Co.; London: E. & F. N. Spon.

Electric Motors, their Installation, Control, Operation and Maintenance. By Norman G. Meade. Size, 7½ by 5½ in.; pp., 159. Ills. Price, $1. New York: McGraw Publishing Company.

Gas, Gasoline, and Oil Engines, Including Producer-Gas Plants. By Gardner D. Hiscox. Size, 9 by 6 in.; pp., 476. Ills. Price, $2.50. New York: The Norman W. Henley Publishing Company.

House Painting, Glazing, Paper Hanging and Whitewashing. By Alvah Horton Sabin. Size, 7½ by 5 in.; pp., 121. Price, $1. New York: John Wiley & Sons; London: Chapman & Hall.

The Theory, Design and Construction of Induction Coils. By H. Armagnat. Translated and edited by Otis Allen Kenyon. Size, 8½ by 5½ in.; pp., 216. Ills. Price, $2. New York: McGraw Publishing Company.

Bestimmung des Maximalwertes des thermo-dynamischen Wirkungsgrades und der günstigsten Stufenzahl bei Dampfturbinen. By A. Wenger. Size, 8½ by 5½ in.; pp., 84. Ills. Price, M. 3. Berlin: Julius Springer.

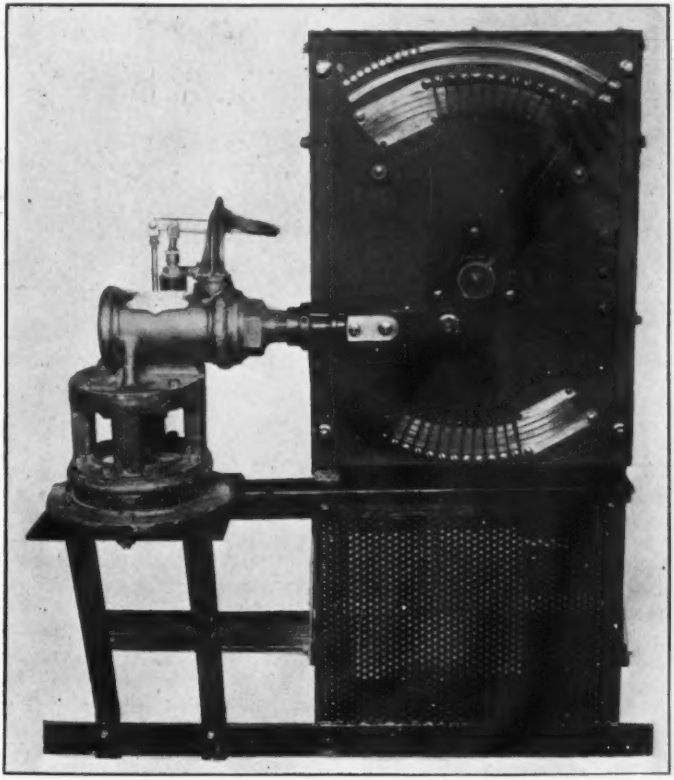
Locomotive Engine Running and Management. By Angus Sinclair. Twenty-second Edition. Size, 7½ by 5 in.; pp., xxxvi, 438. Ills., 55. Price, $2. New York: John Wiley & Sons; London: Chapman & Hall.

Telephone Construction, Installation, Wiring, Operation and Maintenance. By W. H. Radcliffe and H. C. Cushing. Size, 7 by 4 in.; pp., 171. Ills. Price, $1. New York: The Norman W. Henley Publishing Company.

The Building Mechanics' Ready Reference: Plumbers', Steam-Fitters' and Tinners' Edition. By H. G. Richey. Size, 7 by 4 in.; pp., 529. Ills., 201. Price, $1.50, 6/6. New York: John Wiley & Sons; London: Chapman & Hall.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Pressure Controlled Speed Regulator. THE controller described herewith is designed for use in connection with the electric motor operating the blower of a mechanical stoker, boiler feed pump, gas pressure blower, etc. For mechanical draft systems, the controller is so arranged as to adjust the speed of the motor and the blower driven by it to the number of revolutions per minute necessary to furnish the amount of draft required for a given demand on the boiler. So long as the steam pressure is constant the speed of the motor is not changed, but any variation in pressure above or below the amount for which the controller is adjusted results in a decrease or increase of motor speed, the draft being thus automatically regulated so as to keep the boiler pressure practically constant.



The complete controlling equipment

for use in connection with a direct current motor consists of a standard manually operated starting rheostat (provided with no-voltage release) and a special speed regulator designed to vary the speed of the motor in accordance with variations in the pressure of the boiler system served by the stoker. The speed regulating part of the equipment may be designed to reduce the speed of the motor below its normal rated speed by inserting resistance in the armature circuit, or to raise the motor speed above normal by field weakening, or by a combination of these two methods, to provide for any percentage of speed variation within the limits of standard practice for motor speed regulation.

The appearance of the direct current blower regulator designed for armature regulation only, is shown in the accompanying illustration.

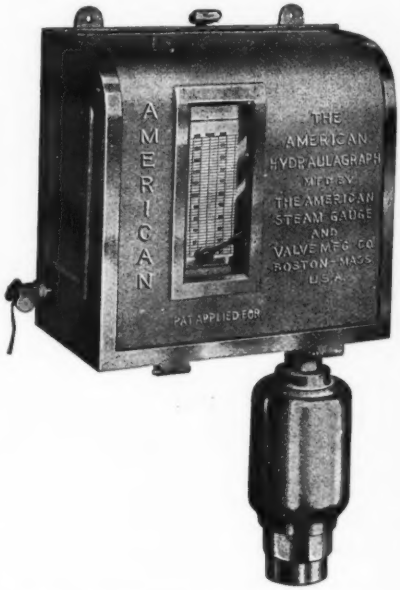
The blower regulator consists of a slate panel mounted on the front of an angle iron cage, the panel carrying the contact segments, over which a double ended lever moves, and the cage containing the necessary regulating resistance.

The lever is actuated by the piston of an hydraulic cylinder, the admission and exhaust port valves of this cylinder being in turn controlled by the movement of a pressure regulator diaphragm, one side of which is subjected to the boiler pressure. The normal boiler pressure on the under side of the diaphragm is balanced by a weighted lever bearing upon the top of the diaphragm in such manner that this lever will rise or fall as the boiler pressure rises above or falls below the normal pressure for which the lever is counterbalanced. This up and down movement of the lever operates a pilot valve controlling the admission of water to the hydraulic cylinder shown to the left of the slate panel and, due to this pressure, the piston of the cylinder is moved back and forth, operating in turn the double ended lever which rides over the contact segments mounted on the slate.

This speed regulator is made by the Cutler-Hammond Mfg. Co., Milwaukee, Wis., who will send full information on request.

The Hydraulagraph.

ON all car equipment, every detail which makes for strength or safety is so important that it hardly seems fair to select any one feature as being most important; yet if there is any one most important feature, it must be the safety of the trucks. Nothing is so baffling, both to railroad officials and to the state inspectors and commissioners as the absence of a record assuring the original



security or strength of material, or careful inspection of every detail of car equipment before it has left the shop. For instance, in the important detail of pressing wheels on axles, there has never been until now a successful method for making accurate diagrams of the ram movement in an hydraulic wheel press. Such an instrument, however, has been produced by the American Steam Gauge & Valve Mfg. Company of Boston, and it is known as the "Hydraulagraph."

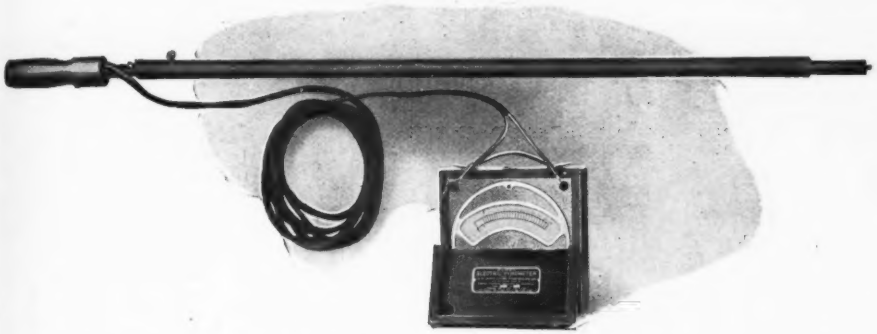
Prior to the invention of the Hydraulagraph, this company has been manufacturing a maximum pressure recording gauge, which, while one of the best made, still failed to accomplish

fully the purpose for which it was designed, principally because the operator knowing that a maximum pressure was demanded could get the prescribed reading on the diagram of the recording gauge by simply continuing the pressure after the wheel had reached the shoulder, when in fact the wheel might have been so loose that it was a menace to safety from the moment it was put on. The hydraulagraph, however, is built on an entirely different principle, following the general design of a continuous steam engine indicator but adapted to Hydraulic work. By this method a spring of great power of resistance and accuracy is obtained, and, by means of an air chamber to take up the vibration which naturally must follow the tremendous pressure of the wheel press running up into 200 tons, a diagram is obtained with as clear a line as the diagram of the American-Thompson Improved indicator card. The moment the operator attempts to get the required maximum pressure on a loose fit, the diagram shows a vertical line. There is no way of disguising this, neither can the operator by any means obtain access to the diagram or pen. In fact, any effort on his part to hold the pen by means of such ingenious devices as he might make to reach down to it would only result in breaking the pen. The only portion of the diagram accessible to the operator, therefore, is the marginal space left purposely for him to record wheel data, which is a necessary part of his work, and one of the most valuable records achieved in recent years toward the safeguarding of the public.

The chart is 100 feet long. Each quarter inch represents an inch movement on the ram, and the roll can easily record 400 complete movements, or 200 pairs of wheels.

Portable Electric Pyrometer.

THE Wm. H. Bristol electric pyrometers have become well known in many processes where the temperatures



lower than 2,000 degrees are used. These pyrometers have been made in both switchboard and portable form to indicate or record high temperatures, but most of the instruments now in service are for ranges of temperature lower than 2,000 degrees. There are quite a number of processes in which excessively high temperatures are used and these temperatures should be measured intermittently in order to make control possible and to obtain a uniform product. In experimental work temperatures in the neighborhood of 25,000 F. should often be measured, as for instance in boiler tests where the boiler furnace temperature is to be determined. A new quick reading form of the Wm. H. Bristol pyrometers has been designed and preliminary models tested in actual service in several different processes where the temperatures are excessively high and the requirements very severe. This special pyrometer consists of a compound thermo-electric couple used in connection with a special portable instrument equipped with a pivot jewel

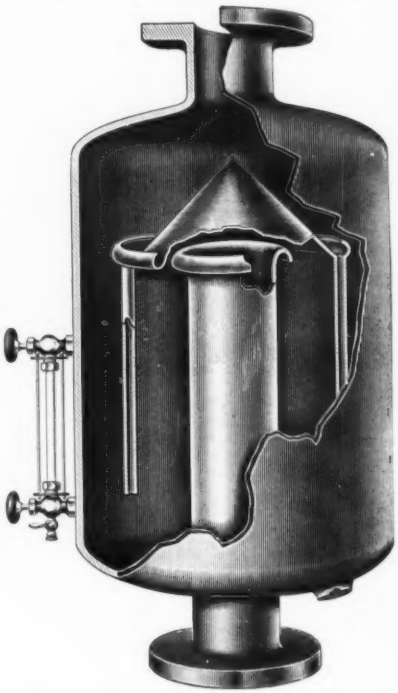
bearing Weston movement. The complete outfit is shown herewith, with the protecting sheath pulled back against a stop leaving the tip of the thermo-couple exposed. When a reading is to be taken with this special thermo-couple it is inserted into the furnace or kiln with the tip protected from mechanical injury, and as soon as the couple has been inserted at the proper point in the kiln, the iron pipe projecting sheath is slipped back so that the tip is exposed to the hot gases whose temperature is to be measured. After a reading has been taken the couple should be withdrawn and partially cooled off before another reading is taken.

This form of couple is the invention of Prof. Wm. H. Bristol, formerly of Stevens Institute, and now president of the Bristol Company.

This quick-reading form of the Wm. H. Bristol electric pyrometers with the compound couple has been tested under very severe conditions and found extremely valuable for such applications as brick kiln temperatures, boiler furnace fire box temperatures, by-product coke oven combustion flue temperatures, soaking pit temperatures, etc. The complete outfit is portable, and readings of temperatures in the neighborhood of 2,500 degrees may be obtained in a very few seconds after inserting the tip of the couple to the point where the temperature is to be measured. By using a special form of the platinum platinum-rhodium tip this type of thermo-couple can be used to measure the temperature of red hot surfaces of metal or other material.

Steel Welded Seamless Receiver Steam Separator.

THE Austin all steel welded seamless receiver separator summed up briefly is just what its name implies; a pressure resisting, rivetless, hence leakless and wasteless, separator for installation in high-pressure steam lines. Placed on the market after many months of application and experiment, involving numerous tests under the most exacting conditions, this separator is claimed by its manufacturers, the Austin Separator Company, of Detroit, Michigan, the highest attainment of its character in effect. The necessity for a leakless separator, guaranteed so, under he highest possible pressure, has been uppermost in the minds of experts familiar with the rapid development in steam practice within recent years. The Austin Separator Company guarantee to maintain through this new devise a reserve of dry steam at engine throttles for varying loads, emergencies, etc., without the slightest leakage, regardless of pressure.

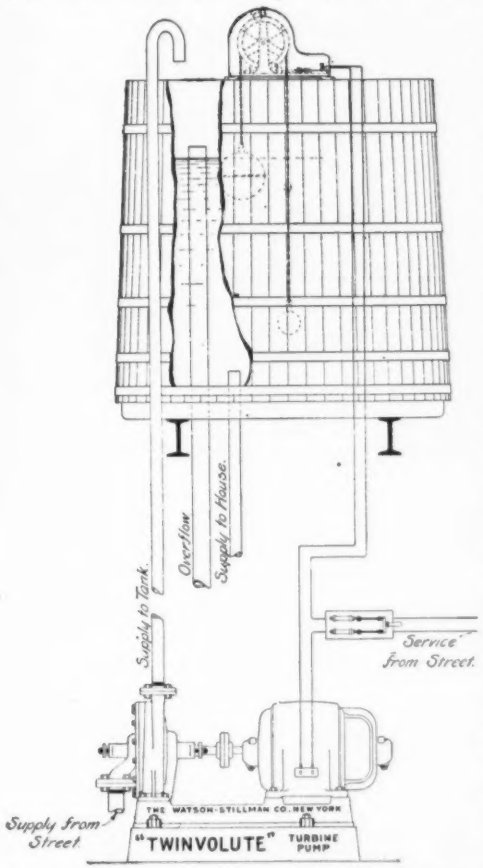


The accompanying illustration represents a sectional view of the vertical types recently completed and installed in several high-pressure plants where high efficiency has been demonstrated under the most exacting conditions. Open hearth steel plate welded into vertical, horizontal or angular shapes, with flanges absolutely true, no seams, rivets or bolts, with an efficiency of 99.81 dry steam, this new design

promises to supersede all other types of separators. The descriptive literature being circulated by the Austin Separator Company at 26 Woodbridge street, Detroit, Michigan, may be had on request.

Watson-Stillman Automatic Tank Switch.

THIS device is offered as a decided improvement in switches for automatically maintaining the water level between desired limits in open tank or sump systems. The construction is novel, permitting the switch to be placed on top of the tank or sump cover, and permitting any desired variation in water levels to be carried without relocating the electrical apparatus. When the switch is placed on top of the tank, as in this instance, there is no necessity for boring into the side of the tank, and there is no danger of the switch flooding and becoming short-circuited.



The operation of the Watson-Stillman switch in starting and stopping the motor is dependent upon the movement of a falling hammer, the movement of which in turn is governed by a freely suspended copper float nearly counterbalanced by a cast iron ball. Two small wooden balls on a chain are adjustable, and their position determines the variation of water level between operations of the pump. As the float rises the ball comes into contact with a projection on the hammer and carries the hammer past the center. The hammer then falls to the other side of the pulley shaft by gravity, and in doing so, a lug strikes a projection on the switch and disengages the knife, thus stopping the motor and pump. The switch movement is quick. There is no chance for arcing, and as the hammer remains in contact with the switch arm, there can be no rebound. The hammer holds the switch arm in this position until falling of the water level brings the other wooden ball into contact with the hammer lug, which reverses the hammer, throws the knife into contact and starts the pump again. The wheel acts merely as a carrier for the copper chain. It plays no other part in the operation of the switch.

As arranged for draining sumps, the copper float and iron ball are reversed. This reverses the switch action to start the pump when the water level gets too high. Dampness will not affect the working qualities of the switch when it is placed in the pit. The knife arm is thoroughly insulated from every other part of the switch, and the two contact points are mounted upon a slate block. A suitable opening is provided in the body for inserting the tube and making the connection to the binding posts. No

parts of the switch need oiling or other attention. The shaft is bronze to prevent corrosion and all parts are extra strong. All working parts are enclosed in a heavy cast iron case which protects them from the weather and from sudden injury. This switch may be had in single or double pole and for all ordinary currents and voltages. It is made by the Watson-Stillman Co., 50 Church street, New York.

200-250-Volt Tungsten Lamps.

THE advantages and economy of the tungsten incandescent over the carbon filament lamp have been practically denied to most circuits operating at 200-250 volts, because the regular multiple tungsten lamps were designed for the standard voltage of 100-125. On these larger voltage circuits, for example, 220 volts, in order to use tungsten lamps at all it was necessary to operate two 110-volt lamps in series. Most users of the higher voltages preferred to wait for the advent of the tungsten adapted to their voltage. In answer to this demand, the General Electric Company has extended its production of tungsten lamps into voltages from 200-250. This gives to the users of higher voltages the opportunity for the adoption of the economical high-efficiency lamps for multiple service. The regular G. E. 200-260-volt carbon filament lamps ranged in efficiency from 3.8 w.p.c. to 3.1 w.p.c. The new tungsten has the usual tungsten efficiency of 1¼ w.p.c. They posses all the excellent qualities of the regular G. E. 100-125-volt tungsten lamps, including the same form of specially anchored filaments which make the G. E. 100-125-volt lamps so successful. Thorough and ample tests of the new 200-250-volt tungstens show exceptionally good results, the average life and performance of these lamps being fully up to that of the standard multiple lamps.

Boosting Gas Pressure.

AN installation of Westinghouse gas engines for boosting the pressure in its illuminating gas pipe lines, has recently been contracted for by the Public Service Corporation of New Jersey. At its Hoboken and Passaic plants, four Westinghouse vertical, 13-inch by 12-inch, gas engines, equipped with special regulating mechanism, will be employed to drive direct-connected Root blowers delivering gas at pressures varying from three-fourths of a pound to four pounds per square inch, as desired. The delivery of gas by the blowers is automatically made to conform to the demand on the gas lines, by increasing the speed of the engines as the pressure in the mains tends to fall. To accomplish this a special controlling valve has been added to the engine equipment, which throttles the fuel admitted to the engine, adjusting its speed between 290 and 125 revolutions per minute, as the demand for gas varies. The controlling valve is operated by a piston, to which pres-

sure from the gas-reservoir line is admitted, and which moves against the compression of a helical spring to close the fuel valve as the line pressure rises. The controlling valve is fitted with a positive stop so adjusted that, even though the line pressure reaches its full value, the fuel valve cannot close beyond a point where the engine will continue to turn over on light load, thus avoiding the necessity of restarting the engine when the blower pressure is again required. While it is estimated that the minimum demand on the pipe lines will probably absorb the delivery of the blower at its lowest speed (125 revolutions per minute), any possible abnormal rise in pressure is prevented by the provision of relief valves which automatically open a by-pass around the blower, enabling the engine to run light while performing no other work than circulating the gas in its local circuit. A standard governor device has also been supplied with these engines, designed with considerable play or backlash, so that the governor does not control the gas admission until the engine speed exceeds 250 revolutions per minute. Above this, the governor travel takes up the backlash, throttling the gas and preventing any possibility of overspeeding in case the pressure in the transmission line should suddenly be relieved.

The location of the boosting equipment dictated the use of a magnet generator for ignition current, driven from the main engines. The feature of obtaining approximately constant speed for the ignition-current generator run from an engine of widely varying speed, is unique. A Holtzer-Cabot WS magneto equipped with a governor pulley, is employed. The magneto, designed to run at 2,000 to 2,500 revolutions per minute, is driven by friction contact with the side face of the fly wheel rim, which varies in speed from 125 to 290 revolutions per minute, the governor acting to withdraw the pulley momentarily when its speed exceeds normal rating, so that whatever the speed of the engine, the magneto runs at approximately constant speed.

Industrial Notes.

—E. M. Dart Mfg. Co., Providence, R. I., are distributing a unique and handsome watch fob in the form of a replica of the Dart union coupling. It is made of a non-corrosive composition metal having the appearance of oxidized silver. They will send one of them on receipt of a 2-cent stamp to any reader of THE ENGINEERING MAGAZINE. Only one will be sent to any one person.

—A. M. Morse, Chicago district manager for Harrisburg Foundry & Machine Works, reports among recent sales of Fleming-Harrisburg engines for direct connected electric generating sets the following: Thomas B. Jeffery & Co., builders of Rambler automobiles, Kenosha, Wis.; Indiana Springs Co., "Mudlavia," Kramer, Ind.; Northern Indiana State Soldiers' Home, La Fayette, Ind.; C. H. Campbell Furniture Co., Shelbyville, Ind.; G. Heileman Brewing Co., La Crosse, Wis.; L. S. & M. S. R. R. Co., Toledo, O.; Lehigh Valley R. R. Co., Bound Brook, N. J.; Delaware, Lackawanna & Western R. R. Co., Buffalo, N. Y. The engine for Thomas B. Jeffery & Co. is of the Harrisburg improved Corliss-valve non-releasing gear type, and will drive a 360 K.W. alternator at 150 R.P.M., having the exciter as well as the alternator directly connected to the engine shaft.

—Conrad A. Dieterich has retired from the firm of Stratey & Hasbrouck and has removed his offices from 257 to 45 Broadway, New York. Mr. Dieterich will continue in practice of law, as heretofore, devoting particular attention to the soliciting of patents, trademarks, and copyrights and all litigation affecting the same.

—The Western Electric Company announce that they are now in a position to furnish Sunbeam tungsten lamps in voltages between 200 and 250. The lamps are made in four sizes at present, namely, 45, 70, 112 and 180 watts. They are of the Sunbeam quality and have given equally as good satisfaction as tungsten lamps of 110 volts range. Information and price may be obtained at the West-

ern Electric Company's nearest branch house.

—The Garwood Electric Company announce that they have appointed the Atlanta Brokerage Company, Atlanta, Ga., as sales agents for the State of Georgia, and for the States of Oregon and Washington, Montilius Price Company, 525 New York Block, Seattle, Washington.

—The Turner Construction Company, New York, have just been awarded the general contract for a reinforced concrete factory building for John F. Galvin, East avenue and Thirteenth street, Long Island City. This building will be 200 feet by 100 feet, and six stories and basement in height. Work will be undertaken at once. They have also just been awarded the contract for the new factory building for the Royal Baking Powder Company, Kent avenue and Morton street, Brooklyn. This building will be of reinforced concrete throughout, 216 feet by 53 feet, and six stories high.

—The Northern Water Softener Company, Madison, Wis., have closed the following contracts: Cedar Rapids & Iowa City Railway & Light Company, Cedar Rapids, Iowa, for a 20,000-gallon per hour machine; Power Construction Company, Galena, Illinois, for a 15,000,-gallon per hour machine: Sandusky Portland Cement Company, Sandusky, Ohio, for a 10,000-gallon per hour machine; Webster City Electric Light & Water Works, Webster City, Iowa, for a 2,000-gallon per hour machine; Los Angeles Paper Manufacturing Company, Los Angeles, California, for a 2,000-gallon per hour machine.

—Arrangements have been perfected for opening a permanent sample exhibition at Berlin in the Spring of 1910. This exhibition is designed primarily as an exhibit of distinctively American products, and the management is especially desirous that American manufacturers of novelties shall take part. The intention is to make apparent to the people of Europe, and especially Germany and the continent, the importance and excellence of American manufactures, and to this end the German committee will advertise the exposition throughout the continent and will co-operate with American manufacturers and exporters in every way to popularize and exploit American products. The headquarters of the American committee is at 77 Broad street, New York.

—The Raymond Concrete Pile Company, of Chicago and New York, has secured the contract for placing Raymond concrete piles in the foundations of an automobile building for Haberer Brothers, Gest and Evans Streets, Cincinnati, Ohio.

—Garwood Electric Company announces that it has appointed the Charlotte Contract Company, Charlotte, N. C., as sales agents for North Carolina and South Carolina.

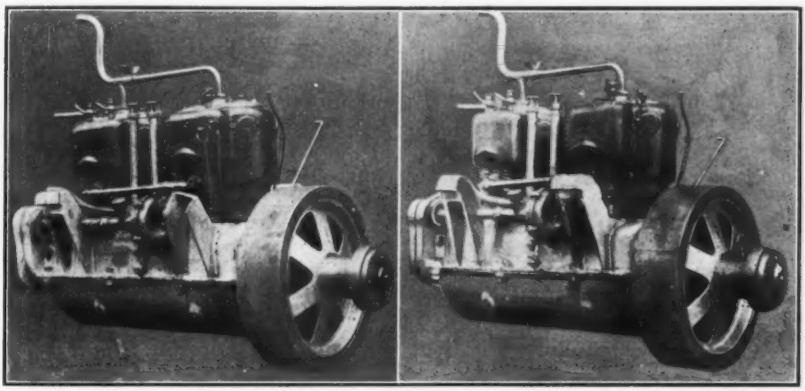
—The United Illuminating Company, Bridgeport, Conn., is installing a Westinghouse 500-kilowatt steam turbine for driving a 650-kilowatt-ampere, 2400-volt, three-phase, 60-cycle Westinghouse alternator which is to feed into the distribution system serving the city of Bridgeport and surrounding territory with light and power. The present installation is in addition to the existing equipment of a 300-kilowatt Westinghouse turbine driving a Westinghouse alternator, besides several small belted units.

—The transmission dynamometer invented by Prof. W. H. Kenerson and illustrated and described by him in a paper read before the meeting of the American Society of Mechanical Engineers at Washington in May, 1909, is a device which indicates, by means of a pressure gauge, the amount of power transmitted through it. The dial on the gauge is graduated to show the horse power per hundred revolutions per minute of the shaft to which the dynamometer is attached. It is sensitive and correct to a degree very closely approximating that of the ordinary gauge for indicating pressure and the construction is such that it cannot easily be deranged. This transmission dynamometer is being built and placed on the market by the Builders Iron Foundry, Providence, R. I.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Oxy-Acetylene Welding.

AUTOGENOUS welding with acetylene offers a number of advantages over the older oxy-hydrogen process. The temperature of the oxy-hydrogen flame is something less than 4,000 degrees F.; that of the oxy-acetylene flame is about 6,300 degrees F. Further, the structure of the oxy-acetylene flame is such that the heat is concentrated in a small primary flame, from which it is very rapidly given to the surface to be welded. The much larger flame of the oxy-hydrogen blow-pipe loses much of its heat through conduction and radiation.



The substitution of acetylene for hydrogen, however, intensifies a difficulty which exists to a certain degree in oxy-hydrogen welding, the danger of impairing the chemical and physical properties of the welded metal by the use of an improperly proportioned gas mixture. In either process excess of oxygen in the mixture results in oxidation of the metal. A slight excess of hydrogen in the oxy-hydrogen mixture produces a flame with reducing properties without introducing deleterious effects. But the carburizing effect of an excess of acetylene is equally injurious with oxidation; hence, to produce perfect results in oxy-acetylene welding, the flame must be absolutely neutral. The difficulty of maintaining the proper mixture ratio to produce this neutral flame transcends all difficulties of manipulation in the oxy-acetylene process; and since the mixture is controlled by the torch and its subsidiary devices, these apparatus are the paramount element in the success of autogenous welding with acetylene.

The problem of producing a torch uniformly and constantly to maintain a properly proportioned gas mixture at proper pressure when once adjusted for the particular class of work in hand has been solved with conspicuous success by the Davis-Bournonville Company, who after many years experience in the man-

ufacture of acetylene generators for lighting and other purposes have recently begun the development and manufacture of appliances for oxy-acetylene welding and metal cutting. To the torch of A. Boas Rodrigues & Co., selected as

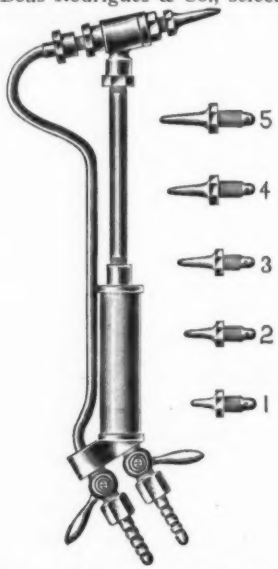


FIG. I. SMALL TORCH AND TIPS.

the most successful of European apparatus, the United States patents for which the Davis-Bournonville Company have secured, improvements in detail have been made which enable the company confidently to offer the torch now on the market as representing the highest development of autogenous welding apparatus.

in hose connections, and at the other in a recessed head which receives the torch tips. The acetylene pipe is screwed into a cylinder about 1½ inches in diameter, packed with a porous material to prevent the possibility of back-flash beyond this point; the cylinder serves as a convenient handle in operating the torch. The tip, however, is the important feature of the torch. Each change of tip gives the equivalent of a complete torch of different capacity. The idea of supplying interchangeable tips did not originate with the Davis-Bournonville Company; but they claim that in no other apparatus are incorporated for every change in capacity the changes in length, interior diameter, oxygen inlet, and acetylene inlet of the tip which are essential to the attainment of the most perfect results.

In the section of the tip shown in Figure 2, A is the oxygen, BB the acetylene inlets, and C the mixing chamber. The oxygen and acetylene inlets are exactly proportioned to each other in each size of tip, and to the inlets are proportioned the length and diameter of the mixing chamber. The oxygen, entering at a higher pressure than the acetylene, acts as an injector; the acetylene, striking the oxygen jet at right angles, produces a disturbance in the oxygen column which results in a perfect mixture of the gases. The mixture is discharged at a pressure at the point of the tip which is not sufficiently high to cause the molten metal to be blown away from the weld, a material advantage in welding.

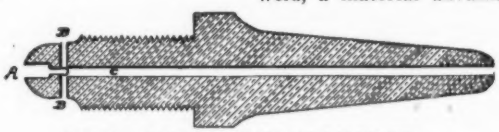


FIG. II. INTERCHANGEABLE TORCH TIP.

The means by which control of the gas mixture is secured may be briefly indicated by reference to the two illustrations on this page. Torches are constructed in two standard sizes, with each of which are supplied five interchangeable tips of different capacities. As shown in Figure 1, the torch consists of two small pipes, terminating at one end

When the pressures at which the gases are supplied to the tip are once adjusted by means of the pressure regulators to produce a flame suitable for the particular work in hand, constancy of pressures is secured by means of special regulators applied to the oxygen and acetylene supply pipes; the exact proportionment of the gas inlets in the tip ensures

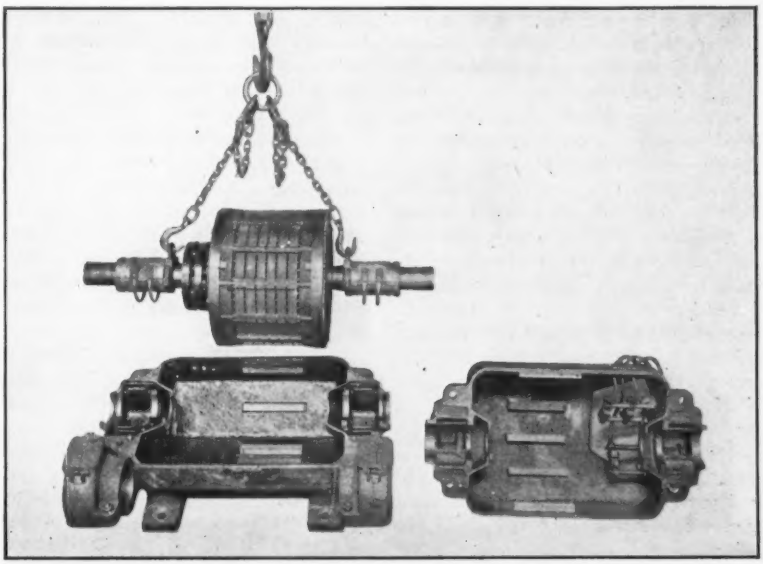
that the gases entering at constant pressure will be supplied to the flame uniformly in the proper ratio.

The use of the oxy-acetylene blowpipe is not limited to welding. It may be used as a putting-on tool, and, by means of a special attachment, for cutting metals. Its applications for these three purposes are exceedingly numerous and are being extended daily. For details, however, we must refer those interested to the literature of the Davis-Bournonville Company. We have space here to draw attention to only one case in which the welding process has been used with complete success, the replacement without stripping of a broken arm on the aluminium crank case of a Stoddard-Dayton automobile motor, which is illustrated on this page.

Besides torches and regulating devices, the Davis-Bournonville Company manufacture and install oxygen and acetylene generating and compressing plants (their acetylene pressure generator has been long and favorably known), and are prepared to supply compressed oxygen and acetylene in tanks. They maintain a demonstrating plant at Marion, Jersey City, at which operators are instructed without charge and which is open to inspection to those interested in the process. Further information will be cheerfully supplied at the offices of the company, at 99 West Street, New York City.

Mill Motors.

THE characteristic features of steel mill service are exceedingly heavy momentary overloads, severe shocks and vibration, abnormally rapid acceleration, application of power at several points remote from one another, high room temperatures, and dust laden atmosphere. Certain operations necessitate a reversal when running at full speed. Reliability of service is absolutely essensential, as the various processes form a practically continuous train of operations and a breakdown stops the whole train. This condition makes it imperative that replacement of damaged parts be made in the shortest possible time. The electric drive has several features which especially adapt it to mill work. Its advantages are simplicity of power distribution, easy and rapid replacement of parts, low cost of inspection and maintenance, flexibility of controlling mech-



anism and adaptability to automatic control. The General Electric Company manufactures a complete line of both A. C. and D. C. motors of especially rugged design for this type of service and these have met with great favor, notably so in steel mills. The corresponding sizes of D. C. and A. C. machines have the same outline dimensions and are interchangeable on the same foundations. The alternating current motors, known as MI motors, are standard at 220 and 440 volts, three phase, 25 cycles, and are furnished in sizes from 3 to 150 horse power inclusive. These motors are built totally inclosed in horizontally split steel magnet frames of octagonal shape, the two halves being held together by a large bolt at each of the four corners. They are supported by four large substantial feet, each foot being drilled for one foundation bolt. Two bails are cast into the upper half of the frame for handling the motor. Each frame has a large opening over the collector which provides a quick and easy means of access for the inspection of the brushes and collector rings. There are other openings which provide additional facilities for inspecting the motor. All openings are fitted with malleable iron covers which are held in place by lock bolts so designed that the covers may be instantly removed.

The most noteworthy feature of this line of motors is the construction by which the stator winding is entirely separate from the frame, resembling in this respect the field coils of a direct current motor. This construction, together with a horizontally split frame, permits of replacing the rotor or stator very quickly and renders it necessary to keep only spares of the parts most liable to damage in stock. The photograph herewith shows the manner in which the upper half of the frame is removed and the rotor, stator and bearings lifted out for inspection or repairs. In making replacements it is not necessary to make any disconnections inside of the motor frame. The stator is built up in the form of a hollow cylinder forming a unit entirely separate from the frame. The punchings are assembled on steel studs which pass through end flanges by means of which the punchings are clamped tightly together. Each half of the frame has several ribs extending lengthwise which are bored to the diameter of the stator and are equal in length to the distance between its end flanges. When the stator is lowered into the frame and the upper half of the frame bolted on, these ribs automatically center it and prevent end motion. Rotation of stator is prevented by ears projecting from the core. End flanges are provided which ensure complete protection to the end windings and permit handling the apparatus freely without damaging the windings. The stator coils are form wound, moulded to exact size and thoroughly insulated before assembling on the core. The conductors are asbestos insulated and the completed coils are insulated with mica and woven asbestos. They are assembled in open slots and are held in place by noncombustible wedges. This construction makes it possible to replace a coil very easily and quickly.

The rotor is built up on a heavy spider, the punchings being assembled between and flanges keyed into place under heavy hydraulic pressure. The rotors are bar wound, in all sizes except the 3 and 7 horse power, in partially enclosed slots. In order that reversal may be accomplished in the shortest possible time and with a minimum loss of energy in acceleration the diameter of the rotor has been reduced to a minimum. The collector spider is carried on an extension of the rotor spider to which it is keyed, making it unnecessary to disturb any connection if it is necessary to replace the shaft. The collector rings are bolted to this spider, making their removal a very simple operation. The rings are of exceptional size and the collector throughout is ruggedly built. The brush holder studs are of steel, are exceptionally large, and are screwed into the frame. Heavy coiled

phosphor bronze springs maintain practically uniform tension over their entire working range and permit a large amount of wear of the brushes.

The bearings are exceptionally large affording ample bearing surface. The armature bearing housings are a part of the frame castings. The bearings are furnished for either oil ring lubrication or waste lubrication. To change from one form of lubrication to the other it is necessary to change only the upper half of the lining. The two halves of the lining are bolted together and a wrought iron bail is cast in the upper half providing an easy means of handling the armature.

Armature end thrust is transmitted directly to the frame by a shoulder in the bearing lining. The countershaft brackets are cast with the lower half of the frame and are heavily ribbed. The caps are bolted to the brackets. Linings for minimum standard countershaft diameter are cast iron babbitted and for maximum standard diameter are malleable iron babbitted. Countershaft bearings are supplied for waste lubrication. Where motors are geared it is an advantage to use, where possible, a countershaft passing through brackets on the motor frame to prevent the gear and pinion from springing apart under heavy loads. The rotor shafts are exceptionally heavy and have pinion extensions at both ends. They can be replaced without disturbing connections. The pinions are made of the highest grade of hammered steel and gears of cast steel. The gear cases can be used at either end of the motor and are bolted to webs on the lower housing of the armature bearing and countershaft bracket.

In order to adapt this type of motor to crane service, the 3, 7, 12 and 20 horse power motors have been designed with a view to facilitating the replacement of the armature in either of two ways. These machines have circular frame heads at both ends, the frame and frame heads both being split. This construction permits of the removal of the rotor by removing the upper half of the frame and lifting it out or removing the head at either end and pulling the rotor out endwise. The heads may be shifted through an angle sufficient to permit of the motor being installed on the wall or ceiling. In these sizes the upper half of the frame is hinged to the lower half, the hinge block being bolted to the frame to permit of their removal if not desired.

Valve-Gear for Heaters and Receivers.

SOME time ago the Harrison Safety Boiler Works, 3138 North Seventeenth Street, Philadelphia, Pa., put out a new type of combined heater and receiver for use in connection with exhaust steam heating and drying systems. The peculiar feature about this heater was the extra large separator attached to and forming a part of it and intended to purify all the exhaust steam delivered by the engine, including not only that entering the heater to heat the boiler feed-water, but also the surplus passing to the heating or drying system. In order to be able to cut the body of the heater out of circuit, as for cleaning or inspection while the heating system continues in operation, a manually controlled valve was provided to shut the separator off from the heater body and another to close the passage between the separator trap and the overflow of the heater, the latter being necessary in order that the trap might continue to drain the separator when the heater was cut out of circuit without allowing steam to enter the heater by way of the separator drain-pipe and trap.

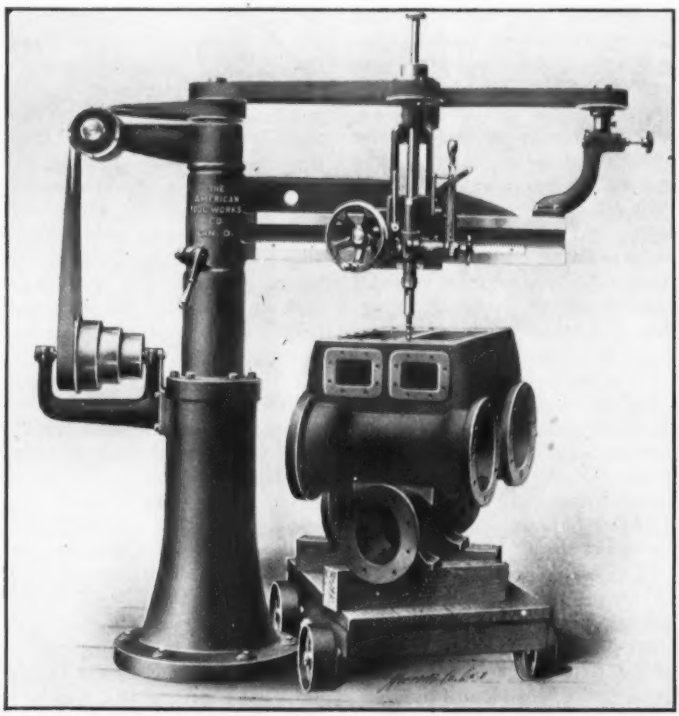
It is obviously necessary that both valves be closed when it is desired to cut the heater out, also that if a man is to enter the heater body while the separator is receiving steam, some provision must be made against accidental opening of the valve. On small heaters it was found practicable to connect the spindles of the two valves together and to turn them by a single lever.

The steam valve between the separator and the heater is of the semi-cylindrical rotating type, and is held against its seat by springs, and also by the pressure of the steam. Where a pressure of

five pounds per square inch or more is carried in the heating system, the total pressure over the valve of a large heater would render operation difficult, by forcing the valve tightly against the seat. In order to obviate this, a special valve gear has been devised. The operating handle is attached to the spindle of the lower valve instead of to the upper, and the lower end of the connecting rod engaging the pin on the short crank of the lower spindle is slotted, so that the lower spindle has a certain excess of motion over that of the upper spindle. The amount of this excess motion is so adjusted that in closing, the upper valve shuts off first, and then stands still while the lower valve rotates through the remaining arc of its motion, which it is enabled to do by reason of the lost motion in the connecting rod. In this way, the upper valve is closed while there is still pressure in the heater to balance the pressure of steam on the outside of the valve. Subsequently the lower valve closes, cutting off the heater, after which any steam contained therein will be condensed or escape from the vent pipe with which an open heater is always provided. Once both valves are closed, the operating handle is removed from its spindle before the cleaning doors of the heater are opened, making it impossible for the steam valve to be opened until the handle is replaced.

Special Type Drills.

THE American Tool Works Co., Cincinnati, Ohio, have been compelled to bring out special designs of their high-speed sensitive radial drill in addition to the regular product. The accompanying illustration shows one of these modifications, mounted on a pedestal base and not equipped with a box table. This type of machine is particularly convenient in the drilling of a multiplicity of holes in work which can be



conveniently moved on a truck or otherwise beneath the spindle of the machine. This does away with considerable handling of the work and permits of its being moved from the drilling department along to the next department with the least possible delay.

This machine is particularly adapted to automobile and gas engine manufacturing plants, and it is due to their request that this particular type of machine was desiged. The arm is easily swung to the position desired and the head readily set at any point along the arm to locate the hole desired. Where drilling with a jig is practiced the work is accomplished very rapidly. A spindle speed of 900 r. p. m. is available, although this may be increased or diminished to suit special requirements. As all the bearings are of the ball bearing type, the drill will stand up to a speed of 2,000 r. p. m. without sign of distress, but of course no twist drill will hold an edge at such speed.

There is an enormous amount of drilling which is most profitably performed on the sensitive drill, when using the smaller sizes of drills up to and including ¾-in. diameter, which must be driven at a high velocity in order to attain their full efficiency. This is particularly true of drills made from high-speed steel. This line of high-speed sensitive radial drills has been developed and built to combine the efficiency of the sensitive drill with the convenience and high productive capacity of the radial. In the drilling of switchboards, automobile chassis, transmission cases and other parts, cash register details, harvesting machinery, and the host of requirements for small hole drilling, this class of machine is unquestionably the most profitable tool for the work.

Industrial Notes.

—The Landgraf-Turner alternating impact testing machine, made by Queen & Co., Philadelphia, is entering into general use for the testing of steels by impact. They have just furnished one of these machines to the Bureau of Standards, Washington, D. C., and have also received an order from the Royal Italian Navy for one to go to Italy by the Italian cruiser which took part in the Hudson-Fulton celebration.

—The Ridgway Dynamo & Engine Company announces the opening of a district office at No. 1311 Schofield Building, Cleveland, Ohio. Mr. H. C. Hale, who has been the Cleveland sales agent for Ridgway apparatus during the past two or three years, will be in charge of this office as local manager.

—L. G. Kibbe has resigned as treasurer of the Wheeler Condenser & Engineering Co. of Carteret, N. J., in order to take an active part in the management of the Warren Steam Pump Co. of Warren, Mass. Mr. Kibbe will be located at the head offices of the latter company at Warren.

—The Bristol Company of Waterbury, Conn., have just established a branch office at Pittsburg. It is located in the Frick Building Annex and an expert will be located there to co-operate with customers whose plants are in the immediate vicinity of Pittsburg, including Newcastle, Youngstown, Wheeling, Scottdale, Johnstown and Oil City. The Bristol Company are making a specialty of studying the application of Bristol's recording instruments in many different industries. For instance, in recording instruments for blast furnaces, including recording pressure gauges for hot blast, top gas and steam, electric pyrometers for hot blast temperatures, top gas temperatures and general tests; electric time recorders for recording the movements of rotary top, skip hoist, large bell, small bell and gauge rod; recording thermometers for Gayley dry blast temperatures, condenser water temperatures, feed water temperatures, etc.

—C. A. Poe has disposed of his interests in Pittsburgh, Pa., and accepted a position with the Wright Manufacturing and Austin Separator Companies of Detroit, Mich., in charge of the mechanical department, succeeding Mr. H. H. Humphrey, deceased.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Cement.

LAWRENCE CEMENT CO., 1 Broadway, New York.—A reference book of 224 pages of highly useful information for all who are interested in cement or concrete construction in any form. A valuable chapter is that on the testing of cement without laboratory equipment. The book is handsomely illustrated.

Digging Machinery.

THE HAYWARD CO., 50 Church Street, New York.—Catalogue No. 36 illustrating profusely and describing in detail orange peel and clam shell buckets, excavators, derrick fixtures, and traveling derricks, coal handling machinery, dredges, etc. The aim is not so much to show types of machines as to illustrate clearly the many uses of Hayward orange peel and clam shell buckets and their application to other makes.

Fans and Blowers.

B. F. STURTEVANT CO., Hyde Park, Mass.—A condensed catalogue showing a complete line of fans and blowers, dust collecting and conveying systems, fuel economizers, engines, motors, turbines, etc. Principal dimensions and other useful information are given.

Fire-proof Windows.

E. VAN NOORDEN CO., Boston, Mass.—Catalogue "D" is a very excellent treatise on the subject of fire-proof windows, skylights, ventilators, etc.

Gas Engines.

DUBOIS IRON WORKS, DuBois, Pa.—A bulletin describing a new type of single cylinder throttling gas engines suitable to operate on natural illuminating and producer gas or gasoline.

Grates.

WASHBURN & GRANGER, 120 Liberty Street, New York.—An illustrated pamphlet describing the Dean dumping, shaking, stationary grates.

Industrial Railways.

ERNST WIENER CO., 50 Church Street, New York.—A catalogue of 132 pages covering every phase of industrial railway equipment in the line of cars, tracks, switches and turntables; in addition a series of tables of value to the prospective or present user of equipment of this character. These tables give capacity, guage of track, overall dimensions of body, diameter of wheels and weight of respective types of cars. There will be found also tables for rails and fastenings required for one mile of single track, tables for one thousand gross tons of rails, fastenings, spikes, cross ties, etc., per mile.

Recording Thermometers.

BRISTOL COMPANY, Waterbury, Conn.—A bulletin illustrating Bristol's Class II. recording thermometers especially adapted for feed-water temperatures. It includes three record charts showing records of actual feed-water temperatures, indicating that a far greater uniformity of operation was secured after the feed-water recording thermometer was installed.

Slide Rules.

KEUFFEL & ESSER CO., Hoboken, N. J.—A leaflet explaining the K. & E. Log Log duplex rule. It is designed especially for the solution of examples and formulas involving fractional powers and roots, as well as natural or hyperbolic logarithms. By it any problem can be solved that can be handled with the ordinary slide rule, and in addition many others heretofore unattempted. It will extract any root or raise to any power, integral or fractional. Hyperbolic logarithms are read direct; sines, tangents and co-tangents are given from one second to 90 degrees.

Steam Turbines.

THE TERRY STEAM TURBINE CO., Hartford, Conn.—An illustrated pamphlet showing the details of the Terry low speed steam turbines for belted or direct connected service.

Turbines and Generators.

BALL & WOOD CO., Elizabethport, N. J.—A brief catalogue of the Rateau-Smoot turbines and generators. The Rateau-Smoot low pressure turbine is operated by exhaust steam making use of it between the limits of the pressure of the atmosphere and the vacuum obtained by means of a condenser. It is a turbine of the impulse type, the entire expansion of the steam taking place in the vanes.

Twist Drills.

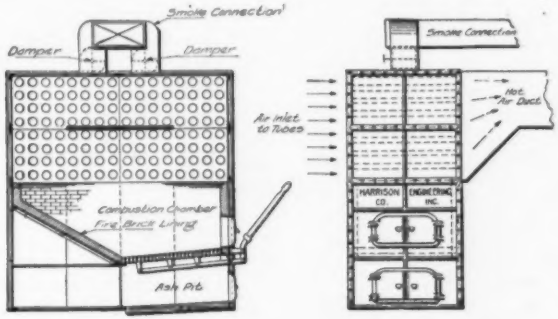
NEW PROCESS TWIST DRILL CO., Taunton, Mass.—A complete catalogue of hot forged increase twist and constant angle twist drills.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Fan System of Heating Without Steam or Water.

EVER since the benefits of the fan system of heating and ventilation began to be appreciated attempts have been made to secure the same satisfactory results without the use of steam. The "electricity direct from coal" idea describes the line of endeavor; or, stated another way, engineers have tried to use a fan in connection with a hot air furnace so that the steam boiler, steam coils, and auxiliary apparatus could be dispensed with. Such a system would revolutionize heating methods—it would mean greater simplicity, and freedom from dangers of explosion, and would effect savings represented by the losses occasioned by the transmission of heat by water or steam and the extra expense of a licensed engineer. These numerous attempts proved that the ordinary hot air furnace is not adapted to the higher velocities of air either in arrangement or extent of heating surface, and with but few exceptions these attempts have met with little success.

The Harrison method of heating has solved the problem by bringing forth a new form of air heater. The Harrison air tube heater resembles a sectional water-tube boiler except that instead of water the air for heating and ventilating passes through the tubes at high velocity, in most cases impelled by a fan. The air tubes, which are 4 inches in diameter and 4 feet long, are located just above the combustion chamber, which is of cast iron lined with fire brick. The hot gases from the fire are distributed among the tubes by a baffle, and give up the heat to the air which the fan forces through the tubes. From the tubes the air flows to the ducts and flues as in the case of the fan system having a steam heater. It is readily seen that this heater takes the place of the boiler, feed water heater, boiler feed pump, return pump, steam coils, traps, and other apparatus.



In addition to saving the initial cost and operating expense of the steam apparatus, the Harrison air tube heater is very economical, for the heat is applied almost direct to the air without the use of any other medium. With steam coils

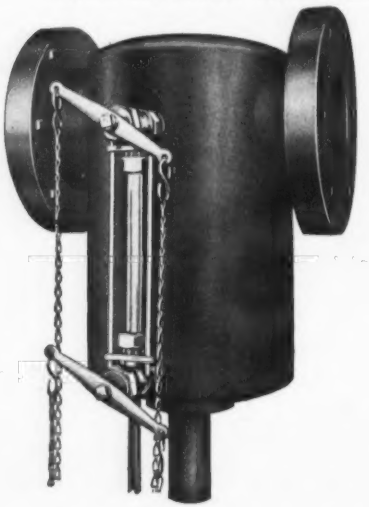
and the use of water for transmitting heat there are always losses due to leakage and radiation. The efficiency of the Harrison air tube heater itself is greater than that of any boiler operating under ideal conditions at full load, and with the Harrison method the total amount of heat wasted by the system is only about one-half as great as in the fan system using a steam heater.

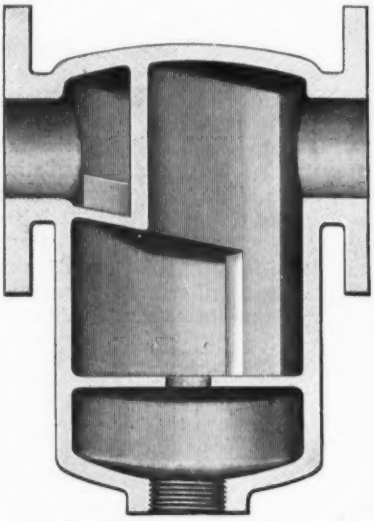
The system is easily cared for by an ordinary fireman, and it is so designed that repairs are quickly made by an average mechanic and in an exceedingly short time. The heater is of cast-iron construction throughout; patent joints between the tubes and tube sheets allow for expansion and contraction and prevent the escape of gas. The casings are in sections and all interchangeable. The heater is of such size as to allow sufficient head room for overhead flues in the basements of school houses and public buildings. Like a sectional boiler its size can be built up by adding more sections.

Further information relating to this interesting system may be had from Harrison Engineering Co., 42 East 23d St., New York.

Curtis Steam Separator.

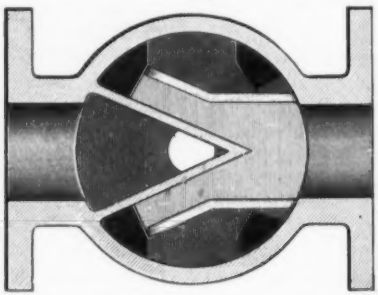
THE accompanying illustrations show exterior and interior views of the Curtis steam separator. These separators are placed in the steam pipe, between the boiler and engine, to separate water and insoluble matter from the steam, and deliver only pure, dry steam to the engine, and are especially useful in combination with boilers having a small





steam space and very rapid combustion, and with marine boilers, where the water in the boilers is affected by the pitching and rolling motion of the vessel.

By referring to the drawing it will be seen that the inner edges of the V-plate



are solid with the separator wall. Upon each of the outer walls of the plate is cast a duct. The walls are cut away below the ducts to permit the exit of the steam, rid of its water or other foreign substance. The steam entering the separator strikes directly against the knife

edge of the V-plate, the water or other matter being caught in the ducts beneath the baffling plate, from whence it cannot return. Any remaining water or impurities are hurled against the inner walls of the V-plate by the velocity of the steam as it passes downward on its way to the outlet. The area through the separator is about one-fourth larger than the pipe size, so that there is no obstruction to the free passage of steam through it. Under severe test the separator has proved its ability to perform the function for which it is intended, furnishing steam free of water under any condition.

This type of separator is made by Julian D'Este Co., 24 Canal street, Boston, Mass., who will furnish further information on request.

Improved Calibrating Apparatus.

THE bursting of machine parts and fittings from excessive fluid pressure is usually accompanied by considerable danger, expense and delays for repairs. This is especially true with the extremely high working pressures under which liquids and air are often used. It is therefore quite important to know the pressure conditions within any apparatus using these sources of power, and for this reason the gauges should be calibrated at regular intervals. Under the higher hydraulic pressures it is frequently the case that the same gauge will show different percentages of error at different pressure readings, and these can be compensated for in ascertaining the true pressure only by comparing with a "master" gauge of known accuracy or by loading with a known pressure.

The outfit which we illustrate performs these two functions of testing by comparison with a master gauge and of testing the accuracy of the master.

For the first, only the part on top of the stand is required. This consists

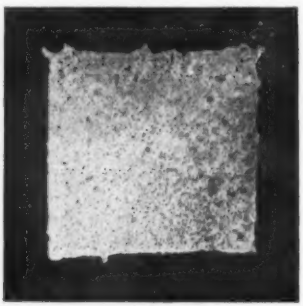
primarily of a cross made of hydraulic bronze. The gauge being tested, which may register any pressures up to 16,000 pounds per square inch, and the master, are attached to the front and back ends of the cross respectively. At the left is a crank-operated screw displacement piston, by means of which the desired pressure may be produced within the pressure chamber. A suitable stuffing box prevents leakage past the piston. To the right end is connected a stop valve and filling cylinder. This permits (1) some of the liquid to be withdrawn from the pressure chamber before removing the gauge being tested and (2) filling after a gauge is put on. There is thus no danger of spilling the oil.

For testing the master gauge, the special weight-loaded hardened and ground steel piston and cylinder are attached at the right by means of flexible copper tubing, as shown. These parts are cut out by a stop valve when not testing the master. The cylinder is long enough to have the center of gravity of the weight below the center of support. When the weights are revolved the friction due to lifting the weights is practically eliminated.

The apparatus is made by the Watson-Stillman Co., of New York.

Protection of Iron and Steel.

BOTH moisture and oxygen are necessary in order that corrosion may proceed, and an efficient protective covering must exclude both of these elements. The most important function of a protective covering, therefore, is to prevent the entrance of oxygen and moisture by forming an impenetrable covering. It is known that a linseed oil covering is very porous, readily taking up moisture, and allowing the entrance of oxygen. The corrosion of iron and steel is an electrolytic phenomenon due to the passage of an electric current from one part of the metal to another,—but this must not be confused with electrolysis due to stray currents. It was to provide an efficient protective coating for such structures as train-sheds, roundhouses, steel tanks and towers, sky-lights, blowers, ventilators, stacks, water and gas meters, reinforcing materials, bridges, iron and steel buildings, structural and plate constructions, etc., that the Glidden Varnish Co., Cleveland, Ohio, have introduced what they term "Acid Proof Coating." This is a priming coat for iron and steel, followed with pigmented coatings, such as graphite, zinc, red lead, etc., followed by a finishing coating of "Acid Proof Coating." This forms a film on the iron or steel surface which prevents any metallic pigments from coming into direct contact with the iron or steel and prevents corrosion due to electrolysis as pointed out above.



The accompanying plate is from a photograph of a piece of sheet iron coated with "Acid Proof Coating"—leaving the center of one side exposed—was subjected to a bath of 30 per cent nitric acid. At the expiration of an hour and forty minutes the entire unprotected part of the metal was completely consumed, leaving a strong film of "Acid Proof Coating," which had not deteriorated in the least. This is an interesting demonstration of its ability to protect iron and steel structures from corrosion and decay due to electrolysis, the weather, acid or alkali fumes, etc.

The Glidden Varnish Co., Cleveland, Ohio, will send further information and a sample to inquirers.

Centrifugal Tachometers.

IN measuring speeds, the principle of centrifugal force has always been employed successfully, owing to its inherent simplicity and freedom from the many difficulties involved in other meth-

TACHOMETER-COUNTER

ods. Essentially, a tachometer of this type consists of masses so mounted on the shaft that they revolve with it, changing their position relative to the axis, due to centrifugal force, an amount proportional to the changes in speed. A pointer is coupled to these masses and will then indicate on a properly graduated dial the rate of speed. In Germany, they have brought these tachometers to a high degree of perfection, both as regards scientific accuracy, mechanical construction and adaptability to all modern engineering needs. One of the pioneers in the field, Dr. Th. Horn of Liepzig, has devoted his life to the subject, and his instruments are said to exemplify today the most advanced ideas in this line. Beginning with the simple tachometer for indicating the rate of speed (answering the question, how fast) there has been developed the portable, single-spindle, multi-speed type illustrated herewith designed for testing any speed of any machine. By a selective speed-changing device, a single instrument can be given several groups of speeds so that it has a total range which may cover everything from twenty-five to twenty thousand R.P.M. The stationary type of tachometer is made in a great many forms to be belted, direct-connected or chain driven from any moving machine concerning which it is desirable to know the rate of speed.

Next is the tachograph, or recording tachometer, with a clock-driven paper chart upon which there is automatically made a permanent record of the speed. The service of these instruments is so varied that Dr. Horn has developed them sufficiently sensitive, and with such rapidly moving charts, that the angular variation in speed of an engine during

TACHOMETER-TACHOGRAPH

one revolution can be plainly indicated, or charts furnished which will run for many days without changing. Combining the indicating and recording features, the tachometer-tachograph results. In practice, the large dial of this instrument guides the operator precisely as to the rate of speed, while the chart, with its indisputable record, proves to the manager whether or not the most economical productive speed has been maintained; shows when the machine was started and stopped, and can be filed

PORTABLE-TACHOMETER

with other data relative to the production.

Another combination instrument, the tachometer-counter, is also illustrated. This instrument answers the question, "how many?" or totalizes the revolutions, strokes, or parts produced as well as indicating the rate. It is compact and is usually direct coupled to the machine. The counter attachment is operated by a shaft from the tachometer.

All of these tachometers are unaffected by temperature, stray fields, magnetism or vibration. Many of them are used in this country for government, scientific and general industrial service. They are imported by the Industrial Instrument Company of Foxboro, Mass.

Largest Self-Cooling Transformers.

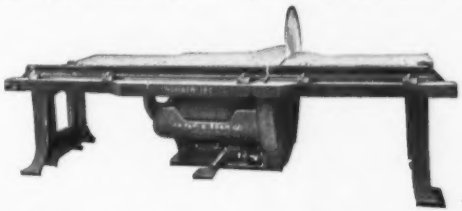
THE maximum size for which a transformer can be built self-cooling is limited by the amount of heat-radiating capacity for which the case can be designed. Standard cases with corrugated sides are regularly supplied with transformers up to about 600 or 750 KVA, but beyond this size the weight and size of case became so great that some method, other than mere increase in size, must be resorted to in order to get the necessary radiating surface. A type of case recently developed by the Westinghouse Electric & Manufacturing Company overcomes this difficulty and is capable of being designed for a greater radiating capacity than has ever been attempted for a self-cooled transformer. It consists simply of a plain boiler-iron case to the outside of which are welded a number of radiating tubes. These tubes are in the vertical position and are given a 90 degree bend at the top and bottom where they enter the case. The mechanical construction is very strong so that there is practically no chance of ever springing a leak. Because of the ease with which the tubes can be widely separated from one another, the air circulates very freely among them and the efficiency of the radiating surface is considerably higher than for the ordinary corrugated case.

There is a growing demand for large self-cooled transformers in sub-stations and other places where water for cooling purposes is either not available or else very costly, or where weather conditions are so severe that water-cooled transformers may give trouble, or where it is desirable to have as little attendance as possible.

The Westinghouse Electric & Manufacturing Company has just built twelve 1,000-KVA, 100,000-volt transformers of this type for the Southern Power Company. Three of these transformers are for outdoor service and nine for indoor.

An Automatic Railway Cutting-Off Saw.

THE machine illustrated herewith is Fay & Egan's latest improved cutting-off saw, designed for cutting off large timbers and material required in car, bridge, ship and mining construction work. It is very heavy and substantial and capable of performing any work within its capacity to which it may be applied. The carriage is mounted on



planed ways on the frame and is moved back and forth by double rack and pinion driven by friction. This arrangement permits the carriage to be advanced at a regular speed for cutting off, by pressure upon the foot treadle, and as soon as the treadle is released the carriage returns. The feed of the machine is driven by gears, no sprockets or chain being used. The carriage is driven by cut rack and pinion, with the pinion located at the center of the travel of the carriage.

One of the good features on this machine is the traversing of the saw carriage by friction, so that the rate of advance is always under control of the operator while the saw is running, and the movement of the carriage is automatically stopped in either direction. The table is equipped with adjustable idler rollers permitting the material to be easily moved across its surface.

The machine has capacity for timbers up to 16 inches by 19 inches.

For further particulars, address the manufacturers at 212-232 W. Front St., Cincinnati, Ohio.

New Thompson Improved Indicator.

WITH all the activity which has been stimulated in the indicator field during recent years, it is interesting to note the latest development of the original Thompson indicator made by the American Steam Gauge & Valve Mfg. Co. This new indicator is styled by its makers the "American Thompson New Exposed Spring Improved Indicator."

Although this new indicator has been in the process of development for some time, it has been but recently placed on the market; yet the success that it has met with and the commendation it is everywhere receiving, make it worthy of special mention, as one of the most practical and successful improvements in the development of indicators since the invention of the detent motion. The manufacturers claim for this new type of their original J. W. Thompson indicator several features of importance, based on the merits of the original patents. One of the basic causes for the superior accuracy of the American Thompson indicator is the short piston rod which the spring surrounds; in other words, the shorter the piston rod, the less liability of binding, and therefore the greater uniformity and accuracy of results. This new type of exposed spring is accomplished without increasing the length or weight of the piston rod to any appreciable extent, thus avoiding any increase of inertia in the moving parts; an error of design liable to be found in outside spring construction.

This design accomplishes all the accuracy originally gained with the short piston rod, with the advantage which all exposed or outside springs possess of being impervious to the effects of heat or cold, and readily changed.

Another and commendable feature of this new exposed type of American Thompson, is the fact that the instrument can be produced for practically the same price as the original enclosed spring.

Industrial Notes.

—Dodge Manufacturing Co., Mishawaka, Ind., have just added Minneapolis and Atlanta to their numerous branches. The branches of this company consist of large stores and warehouses, in connection with expert engineering departments, which make possible the prompt solution of transmission problems and immediate delivery of equipment.

—Mr. Guy H. Gibbs, who has been with the Westinghouse Electric & Manufacturing Company for the past eight years, four of which have been with that company's Cincinnati office, is now with the Western Electric Company at Cincinnati.

—A contract has been awarded to Wm. B. Scaife & Sons Co., Pittsburg, Pa., for several steel frame structures comprising the large addition to the plant of the Allegheny Steel Company at Brackenridge, Pa.

—B. F. Sturtevant Company, the fan, blower and engine manufacturers at Hyde Park, Mass., have established in their works a branch of the Massachusetts Savings Bank Insurance. The work is in charge of an instructor who goes among the men explaining the necessity and value of systematic saving. A large number of their employees have taken advantage of this proposition arranging for insurance to amounts varying from $500 to $1,000.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Electric Motors.

KIMBLE ELECTRIC CO., 324 Washington Boulevard, Chicago, Ill.—A bulletin illustrating the application of variable speed motors to forge blowers, ventilating fans, air compressors, engine lathes, printing presses, etc.

Engineering Instruments.

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y.—A leaflet entitled "Unique Features of Bausch & Lomb Engineering Instruments," designed to show that this firm is making very superior engineering instruments. Some valuable points are given concerning the testing of objectives to determine whether or not the full aperture is utilized, and many of the specially advantageous departures in construction are explained. The line of engineering instruments described is a comparatively new one.

Lifting Magnets.

THE ELECTRIC CONTROLLER & MFG. CO., Cleveland, Ohio.—A profusely illustrated catalogue showing a complete line of lifting magnets for heavy service.

Lubricators.

DETROIT LUBRICATOR CO., Detroit, Mich. —Well-arranged catalogue describing extensive line of sight-feed lubricators, oil pumps, grease cups, oil injectors, valves, etc.

Pliers and Nippers.

UTICA DROP FORGE AND TOOL CO., Utica, N. Y.—Catalogue showing full line of standard and special forms of pliers and nippers for all purposes.

Power Transmission.

T. B. WOOD'S SONS CO., Chambersburg, Pa.—Abridged catalogue No. 24, illustrating couplings, hangers, wall brackets and floor stands of many designs, together with an extensive line of cast-iron pulleys. Gives many useful tables for use in solving problems of power transmission.

Rope.

PLYMOUTH CORDAGE CO., North Plymouth, Mass.—A series of very handsomely illustrated bulletins entitled "Plymouth Products," containing very much interesting information on the manufacture of various kinds of rope and cordage, together with sizes, weights and explanations of names and terms of assistance to the buyer in selecting proper material for his particular needs.

Steam Engine Indicators.

TRILL INDICATOR CO., Corry, Pa.—A catalogue describing Triumph steam engine indicators, reducing wheels and planimeters. It contains some excellent chapters on the taking and reading of indicator cards.

Suction Ashes Conveyor.

DARLEY ENGINEERING CO., 149 Broadway, New York.—Bulletin No. 4 illustrating and describing with much detail a suction system as applied to handling ashes from boilers.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Fuel Economy and the Hard-Water Problem.

THOSE of our readers who have been following the valuable papers on fuel economy which we are now publishing will at once recognize what a vital phase of that problem is the waste of heat energy resulting from the use of scale-forming feed water. No branch of the subject is more fundamentally important than this, and for this reason we take pleasure in drawing attention to the "Eureka" Water Softener and Purifier, an apparatus with which the Dodge Manufacturing Company, of Mishawaka, Indiana, have been obtaining some remarkable results in recent years, particularly in Middle-Western plants.

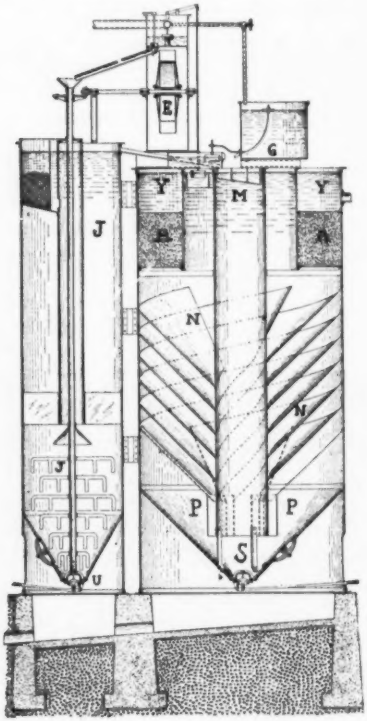
We show two views of the apparatus, one illustrating its general appearance in an actual installation, the other a vertical section showing the details of construction. Water may be supplied to the inlet valve at the top of the apparatus either by pressure or by gravity. A constant head is maintained in the tank in which the inlet valve is located, and the weight of water falling on the wheel E furnishes all the power required to operate the plant. A portion of the raw water is diverted from the inlet-valve tank to the saturator J, where a clear lime solution of constant strength is manufactured. None of the impurities in the lime come in contact with the water to be treated, and no lime particles go over into the piping and boilers. The alkalinity of the purified supply is practically nil.

The series of spiral plates N accelerate the precipitation of the impurities as the water travels upward after the chemical reaction has occurred. The sludge deposited on these plates gravitates into the cone at the lower end of the apparatus, from which it is flushed by opening the valve S. The water, after leaving the spiral accelerators,

passes through a wood-fibre filter A into the reservoir Y, whence it is drawn for use. The apparatus starts and stops automatically as water is required and will supply any quantity up to the rated

capacity. The attention it requires covers only about 20 minutes daily.

The manufacturers claim that the



product is so pure as to be suitable not only for boiler-feed purposes but also for all kinds of high-class work, in laundering, wool scouring, dyeing, bleaching, etc. The system is being installed in large units in a large number of institutions, and a small apparatus designed especially for residences, country houses, cottages, clubs, etc., is becoming widely popular. The cost of operation is practically nothing, beyond the cost of the chemicals (about 2 cents per 1,000 gallons of water treated) and the cost of installation is within reasonable limits. The results of one test quoted by the makers show a return of 44 per cent of the total investment during the first year's operation of the system in a boiler plant working on a hard city water.

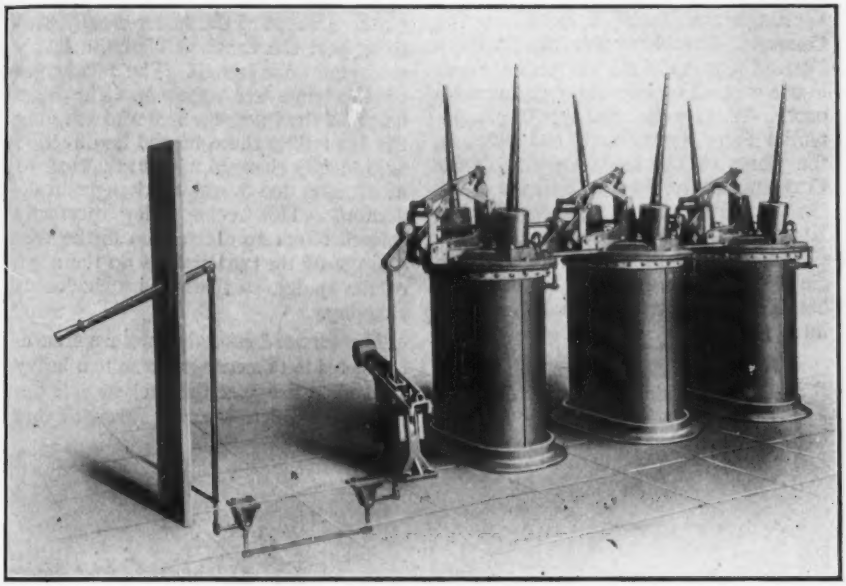
The makers have published some interesting records of this and other results obtained in practice, which they will be pleased to supply to any of our readers who may be interested in the subject. In writing ask for Pamphlet G, on water softening and purification. Address, Dodge Manufacturing Company, Mishawaka, Ind.

110,000 Volt Circuit Breakers.

FOUR groups of 110,000 volt oil circuit breakers were recently put in service by the Southern Power Company on its high tension transmission lines in the vicinity of Charlotte, N. C. This installation is unique as being the first in which switching apparatus is called upon to break currents of this extreme potential, although several similar plants are now under construction and will shortly be in operation.

In the case of the Southern Power Company's lines not only is the voltage interrupted remarkable, but the magnitude of the currents being successfully handled under these severe conditions marks a far step in the design of high tension control apparatus. In this connection it is interesting to note the rated limit of operation of these 110,000 volt circuit breakers, viz., that they shall successfully interrupt any short circuit that may occur on a transmission system of 120,000 kilowatts capacity. A feature of the construction of these circuit breakers is the isolation of each pole in a separate tank. Each pole is thus entirely independent of the others except for the pull rod which operates the contacts.

This rod is released by the tripping mechanism shown at the left of the tanks, allowing the contacts to open by gravity. The 47 inch break thus interposed into each phase occurs in the center of the tank, in oil free from any possible sediment or moisture. By the arrangement of the operating mechanism, gravity assists in making a quick break during normal operation, while in case of any injury to the circuit breaker parts the circuits naturally tend to fall open,—an important safety precaution.



A double break is made at each pole, spring seated butt contacts assuring a firm closure. A small double pole, double throw switch operated by the contact mechanism provides a simple tell-tale, indicating the position of the breaker contacts, by lighting a red or green lamp. The tanks are of welded seam boiler steel, filled with oil and fitted with a thick lining of specially treated insulation which encloses the contacts. The terminals are of the condenser type, and allow the line wires to be brought in directly from overhead.

The 110,000 volt breakers for the Southern Power Company are of both the hand and electrically operated types. They are normally closed by energizing the operating solenoid from a low voltage local circuit, but may also be hand operated by a lever handle through a simple mechanical connection. Series relays, mounted on suspension insulators and inserted directly in the line, are provided for automatically tripping the circuit breakers in case of overload. A wooden rod transmits the movement of the relay armature on the suspension insulator to the latch mechanism, providing a simple and quick acting mechanical release effected directly by the line current.

Fifteen breakers of type and construction similar to the 110,000 volt apparatus will also be installed by the Southern Power Co. for controlling its 88,000 volt transmission circuits. These breakers will be electrically operated and have their tripping coils energized from series transformers "built in" around the terminals and mounted as part of the tank case, as shown in the accompanying illustration. This disposal of the series transformers contributes to the compactness and self-contained character of the breaker group, avoiding all external transformer or relay devices and wiring.

The 44,000 volt lines of the same company are controlled by five sets of breakers of form similar to the high voltage apparatus already described, but designed for operation at the lower voltage.

The 110,000 volt, 88,000 volt and 44,000 volt circuit breakers described in the foregoing are of the type "GA" design, developed and manufactured by the Westinghouse Electric & Manufacturing Company. Elsewhere than the Southern Power Company, these breakers are now in use controlling lines aggregating 200,000 K. W. capacity, and ranging in potential from 44,000 to 88,000 volts, in the plants of the Idaho-Oregon Power Company, Boise, Idaho; Spokane & Inland Empire Railroad, Spokane, Wash.; Niagara, Lockport & Ontario Power Company, Niagara Falls, Ont., and Societa Industriale Italiana, Milan, Italy, besides a number of installations yet incomplete.

Slow Speed Fans.

MODERN business economy demands equipment that not only reduces wear and tear, but also the consumption of power. The Buffalo Slow Speed, Low Power Exhaust Fan has been designed and built to meet these requirements. Run at 20 per cent less speed than a standard exhauster of the same size, it will do the same work with more than a 10 per cent reduction in the consumption of power. In addition to this saving of power, wear and tear, particularly on the bearings, is greatly reduced, as well as vibration and all belt troubles.

The blast wheel is built of heavy steel plate. Instead of the spider usually used to support the vanes or blades, a heavy steel plate cone is used. The advantages of this cone are apparent. The apex being at the inlet, the material entering the fan strikes the cone and its direction is gradually changed without that loss of momentum due to sudden changes in direction. This cone being perfectly smooth offers no obstruction to the free passage of the material, as do the arms of the spider, so there is no chance of clogging.

The forward curved vanes are securely riveted to this cone and also to a heavy steel plate flange at the back or side opposite the inlet, insuring strength and rigidity.

Another feature is the extension of this flange beyond the tip of the vanes. This extension of the flange prevents

any material thrown from the vanes coming in contact with a dead surface, like the side of the housing and its progress retarded. Instead, it is thrown against this flange revolving at the same speed, its momentum is maintained and the material thrown clear into the outlet.

This design of blast wheel is the result of extensive and exhaustive tests to determine the style of wheel with the highest efficiency.

This fan is overhung on a shaft of hardened steel, running in long journal bearings of the double ring oiling type. These bearings are the result of over 30 years' successful experience. They operate smoothly with little attention save an occasional oiling. The bearings are supported upon a heavy cast iron pedestal, in such a manner that the alignment of the fan is constantly maintained.

The housing is adjustable to either hand or angle of discharge. All the necessary adjustments are made in a few moments and on the outside of the housing.

The housing is built of heavy steel plate, securely bolted to a steel frame. The smoothness of this material offers little, if any resistance to the air movement, and friction is reduced to a minimum.

These exhausters are applicable to many industrial needs. Among these is the removal of shavings, saw dust, refuse from wood working machines, refuse from buff and emery wheels and other abrasive processes. This fan is successfully used for conveying cotton, wool and other textiles, spent tan bark in tanneries, long stringy shavings in planing mills, elevating grain, and for many other pneumatic conveyance purposes. Still another use is the removal of gases, acid fumes, smoke and gases generated by forge and furnace fires.

This exhauster is built by the Buffalo Forge Company, Buffalo, N. Y., whose engineers will advise regarding the use of these fans to best accomplish a given purpose.

Effect of Soot on Boiler Tubes.

THE quantity of air admitted to a boiler furnace is a matter having far-reaching effects. With hand firing, frequent opening of doors is absolutely necessary. Advocates of this method say that in this way air is supplied to the top of the coal, and, uniting with the gases rising from the coking fuel causes complete combustion. When the air thus admitted is cold it reduces the temperature of the gases and of the heating surfaces, and in thus retarding combustion increases the deposit of soot. Every engineer and fireman knows that soot is a poor conductor of heat, but to what extent soot prevents heat transmission is not as definitely known.

Some boiler trials were recently conducted to determine this loss. During the first series of tests soot was allowed to remain on the tubes. The evaporation from and at 212 degrees per pound of dry fuel was 6.2 pounds. The dry coal per square foot of grate surface was 13.4 pounds, and the temperature of escaping gases 627 degrees F. Before the second series of tests was made the tubes were carefully cleaned, with the result that the evaporation from and at 212 degrees per pound of dry coal increased to 7.04 pounds of water, a gain of 13½ per cent. The saving is still further evident from the fact that the amount of dry coal consumed per square foot of grate per hour was reduced from 13.4 to 9.09 pounds, and the escaping gases to a temperature of only 546 degrees.

Evidently for best economy cold air must not be allowed to cause the deposit of soot. Perhaps the easiest way to prevent this is the use of a mechanical stoker, preferably the Taylor Underfeed type, which maintains an incandescent fuel bed, the coal being fed beneath the hot coke. Both fan and stoker are driven by the same engine so that the air supply is automatically adjusted to the rate of feeding fuel. The advantage of thus controlling the volume of air is that the air is not only of the proper quantity, but when it has passed through the incandescent coal it is of the high temperature necessary to complete the com-

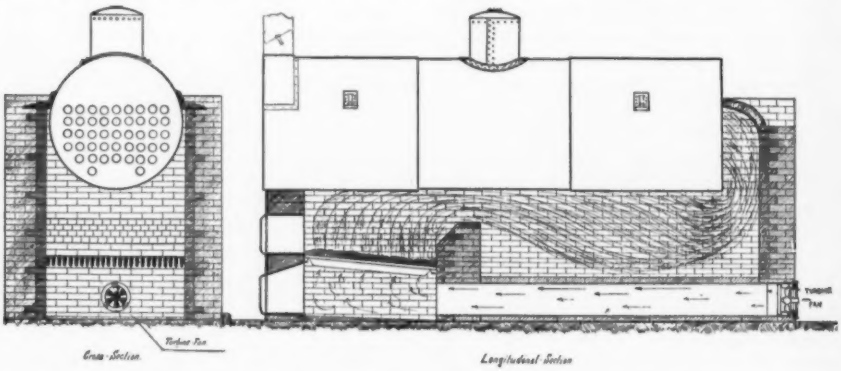
bustion of the gases, and at the same time maintain the high temperature of the heating surfaces.

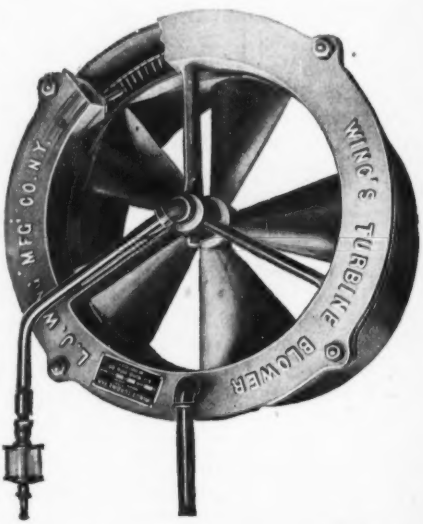
Further information on this interesting question may be had from the American Ship Windlass Co., Providence, R. I.

Turbine Blowers for Mechanical Draft.

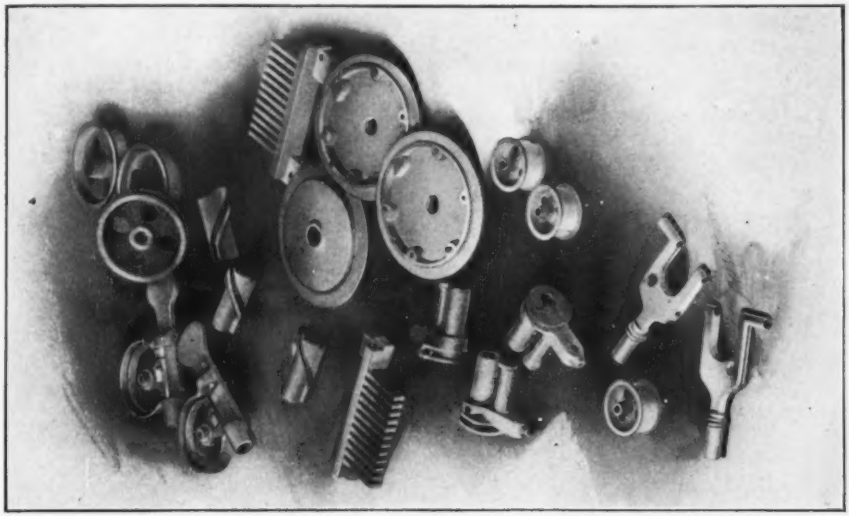
THE subject of mechanical draft is one which, though seemingly well understood, still presents a field in which the apparatus used has seen but little change during the past ten or perhaps twenty years. The average steam user has heretofore considered but two methods of producing his draft, namely, the time-honored, belt or engine driven fan and the aspirator or steam-jet. The "Typhoon" turbine blower is a combination of an up-to-date turbine engine designed to obtain the maximum work from the steam, with a rotary fan of the helicoid type. The illustration shows plainly how this combination is effected to produce an efficient work unit. The hollow cored steam chest with its half-inch steam inlet, holds the nozzles. The steam issuing from the latter impinges directly on the buckets cast by a special process into a bronze ring, to which is fastened the fan proper. The bearing consists simply of a bronze bushing which rotates on the fixed hollow steel shaft, steel surfaces forming the end thrust. The bearing is made dust proof by a cap screwed over the hub of the fan and the whole rotating element is suitably enclosed in a cast-iron casing for complete protection.

The accompanying drawing shows how the blower can be placed directly in the boiler wall, thereby saving costly floor-space, giving separate boiler control, and doing away with repairs, supplies and constant attention. Operated automatically by the damper regulator, the "Typhoon" turbine blower gives a unit which is capable of great flexibility, whose steam consumption is exceptionally low and whose broad range of air delivery and pressure enable all low grade fuels to be properly and efficiently burned, giving at the same time a marked increase in the capacity of the boiler.





The blower is made in four sizes, namely, 12, 16, 20 and 24 inch, suitable alone or in combination for any size boiler. The latest bulletin No. 6 gives complete details of the "Typhoon" turbine blower system for mechanical draft. Further information relating to this interesting system may be obtained from the L. J. Wing Mfg. Co., 90 West Street, New York City.



Franklin Die-Castings.

The attached illustration gives a very clear idea of the possibilities of the Franklin system of die casting, a system which produces castings at one operation as accurately as if they had been machined. The process consists in the use of steel dies for molds in casting machines, the molten metal being forced into the die under very high pressure. In addition to the great saving in cost, this method renders possible at times the casting in one piece of parts that by the usual casting and machining method would require two or more pieces. Naturally, it appears to the best advantage in the casting of small parts required in large quantities.

Full information with respect to the process may be had from the H. H. Franklin Mfg. Co., Syracuse, N. Y.

Industrial Notes.

—The contract for placing 1200 Raymond concrete piles in the foundations of a reinforced concrete shop building to be erected at the Schenectady works of the General Electric Company by the Stone & Webster Engineering Corporation has been awarded to George W. Van Vranken, Schenectady representative of the Raymond Concrete Pile Company of New York and Chicago.

—Paul M. Chamberlain, chief engineer of the Underfeed Stoker Company of America, has resigned from that company to carry on private consulting work at 1522 Marquette Bldg., Chicago. Mr. Chamberlain has in the past been connected with Frick Company of Waynesboro, McCan Mechanical Works of Los Angeles, established and conducted the engineering courses at Lewis Institute, Chicago, and has given particular attention to power plant and factory design, increased efficiencies, fuel economies and smoke abatement.

—The L. J. Wing Mfg. Co., 2111 West Street Building, New York, report recent sales of turbine blowers to Philadelphia Rapid Transit Co., Philadelphia, Pa. 14; Arlington Co., Arlington, N. J.,

5; Reo Motor Car Co., Lansing, Mich., 5; W. J. Raney Co., Mereittsburg, Pa., 8; Standard Chain Co., Columbus, O., 11; Corning Light, Heat & Power Co., Corning, Iowa, 1; Russell, Burdsall & Ward, Port Chester, N. Y., 6; Ft. Wayne Rolling Mills Co., Ft. Wayne, Ind., 7; J. H. & C. K. Eagle Silk Mills, Shamokin, Pa., 8; U. S. Marine Corps, Phila., Pa., 2; Minot Light & Telephone Co., Minot, N. Dakota, 2; Hackensack Water Co., Hackensack, N. J., 5; Selma Lighting Co., Selma, Ala., 3; Maryland Steel Co., Sparrows Point, Md., 4; Peerless Finishing Co., Nyack, N. Y., 6; Witherbee Sherman Co., Mineville, N. Y., 4; Leo Schlesinger, N. Y. C., 1; Blocton-Teller Co., N. Y. C., 2; Bonwit-Teller Co., N. Y. C., 1; Abbott-Alderney Dairies Co., Atlantic City, N. J., 1; Manhattan Soap Co., N. Y. C., 1; Passamoquoddy Ferry Co., Lubec, Me., 1; Adams Coal & Clay Co., Littleton, Ala., 1; Bryden Horse Shoe Co., Catassauqua, Pa., 1; Columbus Forge & Iron Co., Columbus, Ohio, 1; Shamokin Mfg. Co., Shamokin, Pa., 1; Little Cahaba Coal Co., Piper, Ala., 1; Otto Lorence, N. Y. C., 1; Julius Hocke, N. Y. C., 2; U. S. Play Card Co., N. Y. C., 1; Fretz Realty Co., Philadelphia, Pa., 2; Chas. Warner Co., Wilmington, Del., 1; Spang Chalfante Co., Sharpsburg, Pa., 2; S. M. Emery, Vista Hermosa, Mexico, 2; Haddon-Hall, Atlantic City, N. J., 1; Dupree Laundry, 1.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Belt Conveyors.

ROBINS CONVEYING BELT CO., Passaic, N. J.—Bulletin No. 18, carrying much engineering data and useful information concerning belt conveyors.

Blowers.

TURBO-BLOWER CO., 30 Church Street, New York City—A brief catalogue describing the Turbo-Blower, a machine designed to produce in a boiler the draft necessary to burn all classes of fuel in such manner as to effect complete and economical combustion in boiler furnaces.

Boots.

MULCONROY CO., INC., 722 Arch Street, Philadelphia, Pa.—Pamphlet describing the "7-League" boot, a form of rubber boot of particular value to any one engaged in excavating, tunnel work, concrete construction, surveying, prospecting, mining and wet work generally.

Blowers.

L. J. WING MFG. CO., 2111 West Street Building, New York City—Bulletin No. 6 illustrating and describing the application of Typhoon turbine blowers for mechanical draft.

Conveying Machinery.

JEFFREY MFG. CO., Columbus, Ohio—An extensive and well-ordered catalogue, giving a general price list and descriptions of a complete line of elevating, conveying and power-transmitting machinery and chains, together with all accessories.

Elevating and Conveying Machinery.

H. W. CALDWELL & SON CO., 17th Street and Western Avenue, Chicago, Ill.—Catalogue of some 900 pages illustrating and describing with much detail a complete line of elevating, conveying and power-transmitting machinery, machine-molded gears, friction clutches, ice-handling machinery, etc.

Engines.

BRUCE-MACBETH ENGINE CO., 2103 Center Street, N. W., Cleveland, Ohio—A brochure in two colors announcing the consolidation of the Bruce-Merriam-Abbott Co. and the Macbeth Iron Co. under the name of Bruce-Macbeth Engine Co., and illustrating and describing in detail the types of engine manufactured by the new firm.

Feed-Water Heaters.

HARRISON SAFETY BOILER WORKS, 3138 N. 17th Street, Philadelphia, Pa.—Catalogue bearing for its sub-title "How to Use Exhaust Steam Profitably." More than half the book is occupied by discussions and illustrations of the different ways of employing exhaust steam for heating, drying, evaporating, heating water for boiler feeding and for use in dyeing works, tanneries, bleacheries, paper mills, etc.

HOPPES MFG. CO., 63 Larch Street, Springfield, Ohio—Catalogue illustrating and describing in detail the principle of the Hoppes system of live-steam feed-water heaters, purifiers, etc.

General Machinery.

WATERBURY FARREL FOUNDRY & MACHINE CO., Waterbury, Conn.—A catalogue issued as a kind of key to the series of sixteen large catalogues issued by this firm and representing such subjects as automatic cold process nut, bolt and rivet machinery; machinery for manufacturing hinges and butts from sheet steel and brass; cartridge machinery for making metallic cases, bullets, paper shot shells, primers; drop presses, foot presses and screw presses; chain draw benches for tubing and rods; hydraulic draw benches; knuckle joint embossing presses; lathes for burnishing, knurling, trimming and spinning sheet metal; single-acting open back power presses; single-acting blanking and drawing presses; double-acting power presses; rolling mills for rolling sheet brass, copper, steel, tin foil, etc.; shear presses and alligator shears; finishing machinery for sheet brass, german silver, etc.; muffles, casting shops and furnaces.

Lubricator.

DETROIT LUBRICATOR CO., Detroit, Mich.—An extensive catalogue describing a full line of lubricators, oil pumps, glass-body oilers, oiling devices, valves, etc.

Metal Coating.

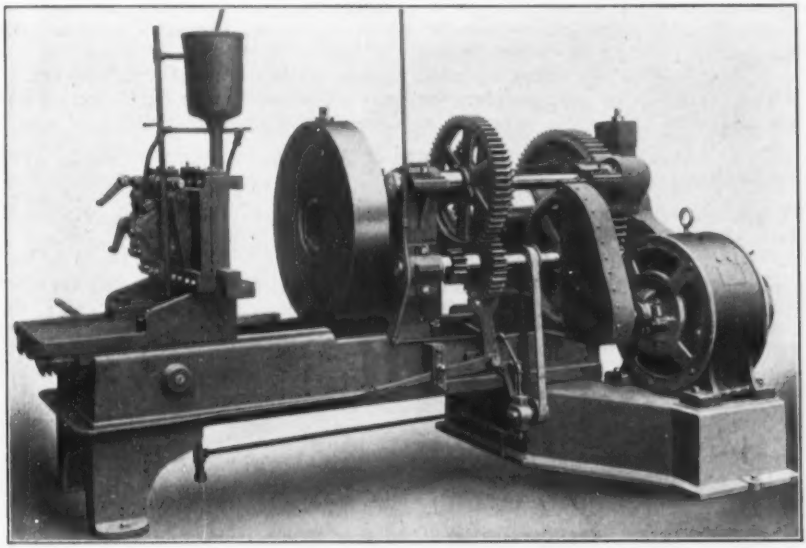
GLIDDEN VARNISH CO., Cleveland, Ohio—Booklet describing acid proof coating and intended especially as a preservative finish or coating for train sheds, round houses, steel tanks and towers, skylights, blowers, ventilators, stacks, water and gas meters, bridges, iron and steel buildings, structural and plate constructions of every kind.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Pipe Threader Driven by Adjustable Speed Motor.

IN securing economy and rapidity of production in many machine tool operations, the individual adjustable speed motor has many decided advantages over other methods of drive. The older methods of speed variation—cone pulleys or gear reductions—provide only comparatively large, rough changes in speed. On the other hand, the adjustable speed motor makes possible fine gradations in the working rate of the tool driven, enabling it to be worked at all times at the proper speed to insure operation at its productive capacity. In many cases the use of the adjustable speed motor has resulted in reducing the cost of the tool taken complete with its adjustable speed motor, aside from the items of increased convenience and improved operation.

The accompanying illustration shows a Westinghouse type "SA" adjustable speed direct current motor driving a machine for cutting and threading pipe from 2½ inches to 8 inches in diameter, built by the Cox & Sons Company, Philadelphia. These machines are designed in sizes to handle pipes up to 18 inches internal diameter, and the special motor drive supplied has proven especially satisfactory. Where quick changes in speed may be required, as in small shops handling a number of different sizes of pipe, such changes can be most easily made with the adjustable speed drive, saving the time lost in shifting gears or belts, and bringing the machine promptly to its most efficient cutting rate. As seen



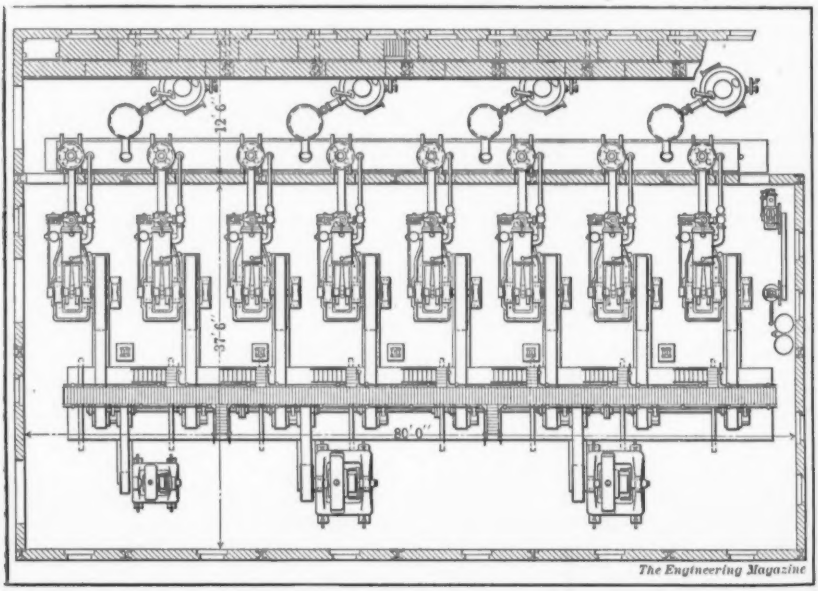
from the illustration, the pipe threader is provided with one set of gear changes, and has an oil system which keeps the cutting tool well flooded with oil. The types of tool holders mounted on the movable carriage are of the most improved design for this class of work. The Westinghouse type "SA" adjustable speed direct current motor gives a speed variation ratio of one to four.

The Gas Engine Power House.

ON page 443 of his "Internal Combustion Engines," Prof. Carpenter says that the hit-and-miss system of governing is theoretically the simplest and, from the standpoint of fuel consumption, the most economical of all systems of governing a gas engine; and on page 554 of the same work quoting from Haeder gives the following table showing variation of fuel consumption with load:

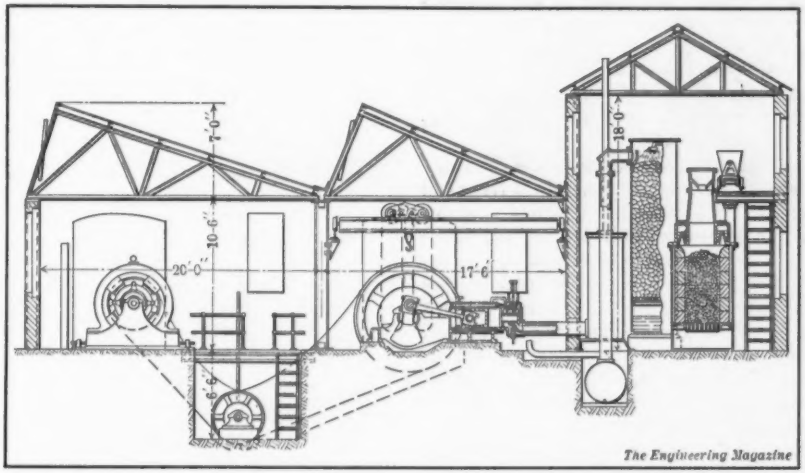
		Variation of Fuel Consumption with Load.								.1 of
Gas Engine.	Max. Load.	.9	.8	.7	.6	.5	.4	.3	.2	Max. Load.
Hit-and-miss regulation	1.	1.03	1.08	1.14	1.23	1.35	1.50	1.8	2.5	3.0
Throttling regulation	1.	1.06	1.13	1.21	1.33	1.50	1.75	2.2	3.0	5.0
Steam plant	1.1	1.05	1.02	1.0	.96	1.02	1.07	1.15	1.30	1.60

Notwithstanding the economic results set forth above as inherent in the hit-and-miss system of governing, it is practically impossible to drive alternators in parallel with any single cylinder gas engine governed on this system, the cyclical irregularity being too great. A single cylinder of the Otto type generates one impulse in four strokes when operating at its maximum power, but as soon as the governor commences to operate there can be but one impulse in eight strokes at the most, and there may be but one impulse in twelve or sixteen strokes. No practical weight of flywheel would suffice to overcome such irregularity of rotative speed due to the intermittent nature of the power application. There is, however, a solution which consist in using multiple cylinders, and heretofore the tendency has been to install tandem and double acting engines. It is not necessary, however, to use either tandem or double acting engines provided a multiplicity of single cylinder engines drive by belt together onto one common jack-shaft, and if the



flywheels are slightly different in diameter there will be no possibility of all the impulses of all the engines "phasing" together. In this way four or more single cylinder gas engines, even though single acting, can be used to drive one common generator.

The load factor in very many installations is constantly varying during the



day. Sometimes the load in the early morning hours will be ⅛ of the maximum load, and the maximum load will last for but two or three hours out of the twenty-four. With any power plant, whether steam or gas driven, where such fluctuations exist, it is impossible to attain the highest coal economy unless the power installation is sub-divided as many times as the maximum load is times the minimum load. While this statement is practically true of a steam plant, it is peculiarly true of a gas plant, since the gas engines' greatest economy is obtained only when it is giving its maximum power. An inspection of Haeder's table shows that when a gas engine operates at half load its fuel consumption increases 35 per cent. Fortunately a gas engine is just as economical in small units as in large,—that is to say a 50 H. P. engine can give a H. P. on substantially the same fuel consumption as a 500 H. P. or a 5,000 H. P. engine. It is for these reasons that the designs of a power house shown herein has been prepared. The gas engine installation consists of eight single acting engines of the Otto type. Each engine drives by belt or rope onto a friction clutch pulley on the jack-shaft. Consequently it is possible to engage or disengage any one of the eight engines at any moment. All the gas engines draw their gas from one common gas tank which is shown occupying a concrete trench, and has an abundant capacity to prevent any pulsation in the gas suction pressure. Separated by a fire proof brick wall from the engines are the producers with their accompanying scrubbers. Each one of these producers is capable of 100 per cent. overload and 50 per cent. underload without materially impoverishing the richness of the gas generated. Even when all eight engines are running simultaneously three of the four producers can readily furnish all the gas needed for the maximum demands of these eight engines indefinitely, so that the fourth producer and its scrubber may be put out of business, dismantled and cleaned without interfering with the continuous performance of the plant at its maximum output. Also any one of the four

producers can be considered to furnish gas for any one of the eight engines.

The jack-shaft is supported on slabs of concrete, insuring the permanence of the alignment of its bearings, and every pulley on the jack-shaft is a friction clutch pulley. It is accordingly possible for the attendant to bring into service or cut out of service any one of the eight engines according to the demands of the moment. For two or three hours of the twenty-four but one engine and the smallest electric generator may be in service, provided this latter is a direct current and not an alternating current generator.

Because of the flatness of the efficiency curve of the electric generators from full load to half load, the electrical generating plant has been divided into but three units, the smaller to be driven by one engine at half its capacity, by two engines at its full capacity, the two larger units to be driven each by two engines at half their capacity and by four engines at their full capacity. With such an outfit it will be possible to keep the fuel consumption down below one pound per B. H. P. hour all the time the reliability of the installation is evident. Such a plant can be operated for twenty-four hours out of the day and for every day in the year. The chances of any serious simultaneous breakdown that would put more than one engine out of business are very small. The fact that the tension side of the driving belts is tending to lift the jack-shaft vertically upward, thereby reducing the pressure on its bearings, is will worth noting. As far as the economy of the electric installation is concerned it should be borne in mind that direct connected generators can only be run at half the speeds possible in the case of these belt-driven generators, so that there is a saving in the cost of the electric generators as an offset against the cost of the jack-shaft and the friction pulleys. The strongest argument in favor of such a plant is undoubtedly its great reliability, and when its superior economy in fuel is considered, amounting to as much as a saving of one-third, it certainly should appeal to power users. This installation was designed by John L. Bogert, engineer of the New York Engine Co., 165 Broadway, New York.

A New Gasoline Blow Torch.

THE illustration herewith shows the extra heavy form of gasoline blow torch, designed for extra heavy heating and brazing, such as propeller shafts, heavy frame-work, steel plates on boilers, hulls of ships and work of similar nature, for heating defective castings in foundries, which is necessary for patching,

plugging and adding missing parts; for brazing the ends of rails together, such as is practiced by street railways and electric railroads to make a secure electrical joint, for releasing and making shrinking fits on heavy machinery and engines, for brazing large iron or copper tubing, for straightening buckets and steel girders, such as are in use by iron ore and coal docks and many other purposes.

It will heat a solid 11½-inch round shaft red hot in about 20 minutes, and to a brazing heat in from 50 to 55 minutes if the heat is properly confined to the work. It will heat shafts up to 24 inches in diameter red hot with a single burner and will make and release shrinking fits of large proportions without any exertion or air pump. In a machine shop it is especially useful in repair work for ex-

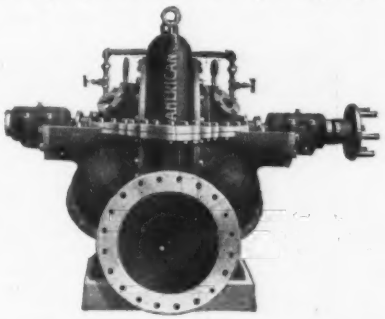
tracting broken taps and drills from work, for brazing broken parts of castings, tools and machinery, for heating shafts between lathe centers for straightening, especially such as armature and crank shafts, a task which is easily accomplished by placing the torch on top of the lathe.

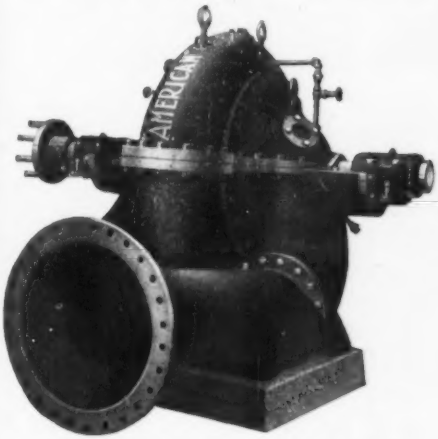
The steel cylinder of the main body is brazed and staybolted, and capable of sustaining a pressure of over 2,000 pounds per square inch. It can be operated between 10 and 200 pounds and will easily maintain a working pressure of from 80 to 140 pounds without any exertion, or the use of an air pump.

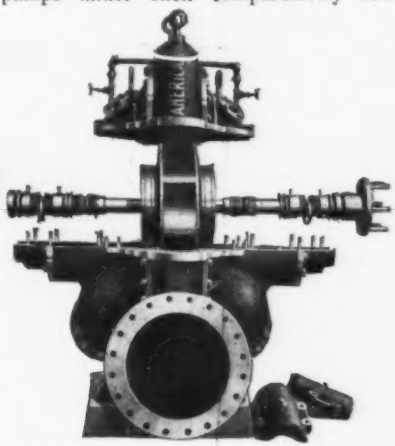
These torches are made in many forms by the Manufacturers' Supply House, Erie, Pa., who will send an interesting booklet on brazing on application.

High-Efficiency Centrifugal Pumps.

IN September of last year efficiency tests were made by Arthur L. Adams, M. Am. Soc. C. E., of San Francisco, on two centrifugal pumps of the American Well Works, intended for use as part of the pumping equipment for irrigating 14,000 acres of land in the San Joaquin Valley, Cal., all of which will be furnished by this company. The pumps tested were of the sizes designated as "20-inch" and "15-inch," these dimensions corresponding with the diameters of the suction connections at the point of inlet into the main casing. The results, which are given in full in a recent pamphlet issued by the company, show that at 288 revolutions per minute, lifting against a head of 26.85 feet, the 20-inch pump had an efficiency of 75.6 per cent; while at 330 revolutions per minute, lifting against a head of 22.69 feet, the 15-inch unit had an efficiency of 77.4 per cent. The lower efficiency of the larger pump is attributed by Mr. Adams to an error in assembling not discovered until after the runs had been made. He characterizes the performance of these pumps under such comparatively low heads as were used in the tests as very gratifying.







In the "American" centrifugal there is no sudden change of direction of fluid

in passing through the pump. The flow is constantly forward in a continuous easy curve and the fluid is discharged in a fraction of a single revolution of the impeller. The impeller is accurately made and machined true to fit the casing, preventing backflow. The double intake equalizes the end thrust and the impeller is balanced to run perfectly true. At the entrance of the discharge pipe is a cut-off which prevents fluid passing the discharge pipe and being repumped. The inner end bearings are provided with water seals to prevent intake of air. The main outer bearings are equipped with ring oilers, keeping the bearings constantly lubricated from oil cellars.

These features not only make "American" centrifugals more efficient, but, in locations favorable for installing this kind of pump, they are most economical.

"American" centrifugals are made in both horizontal and vertical styles, in any number of stages, in any size, and equipped with any power.

The catalogue describing these pumps contains much information not found in any other book on hydraulics and the American Well Works, Aurora, Ill., will send a copy free on request.

An Ideal Factory Floor.

THE facility with which mill and other machinery can be fastened to a wooden floor, gives rise to the use of such floors, even when the balance of the floor construction or the necessary strength is obtained from re-inforced concrete. The usual method of construction in such cases has been to bed

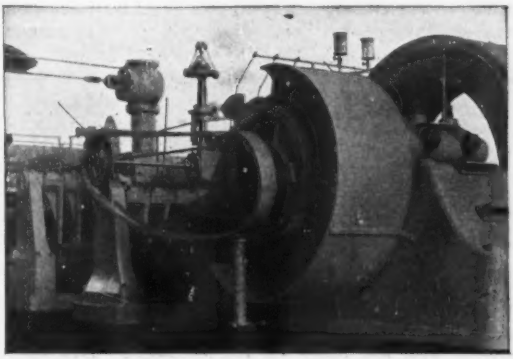
wooden nailing strips in the concrete flush with the surface and nail the floor planks to these strips. In making the plans for the Blake & Johnson factory at Waterville, Conn., the engineers, Griggs & Hunt, of Waterbury, Conn., were confronted with the requirement of a 4-inch wooden floor on the second story although the floor panels themselves were to be of re-inforced concrete. The usual practice of using nailing strips as mentioned above was at first considered, but there is always danger of dry rot where wood is embedded in concrete, and protection against dry rot was essential.

The method adopted was similar to that used under the lower floor in many factory buildings, and seems so admirably adapted to the requirements that it is strange that it has not occurred to others to use it where the wooden floor is required on top of concrete.

For twenty or thirty years it has been the practice where a wooden floor is required directly on the ground without space beneath to omit sleepers and bed the plank directly on from 1 inch to 2 inches of sand mixed with sufficient good heavy coal tar to fill the voids in the sand. This not only protects against decay that would be caused by dampness from the ground, but the creosote oil in the tar also acts as a wood preservative. The foundation has often been of concrete but more usually of cinders or broken stone or gravel, mixed with enough tar so it would compact well under a roller and provide a good, true and level surface for spreading the sand and tar. The mixture of sand and tar provides a perfect bedding for the planks, which are tied together as firmly by the hardwood wearing surface laid at right angles or diagonally as a single floor would be by the use of sleepers. The adoption of this idea on the second floor of the Blake & Johnson factory is shown in the accompanying view. In this case the foundation (the re-inforced slab) was already in; all that was needed was something on which to bed the planks. Sand alone would not answer, as vibration would cause it to shift; but by mixing tar with the sand this danger was overcome and the protection afforded by creosote oils in the tar was obtained. Barrett's sub-floor tar No. 5 was used and about fifty gallons mixed with each cubic yard of sand. The mixture was spread on about 1⅛ inches thick, so it would compact to 1 inch, levelled with a straight edge and while it was still warm and soft the planks were laid on it and tamped until the proper level and stability were obtained. Following the 2-inch plank a ⅞-inch rough pine board was laid and then a surface of 1¼ inches square edge maple. If the experience of twenty or thirty years counts for anything, the planks in this floor will last as long as any part of the building, and if the hardwood wearing surface wears through in places, repairs will be a simple matter.

Chain Governor Drive for Close Regulation of Steam and Gas Engines.

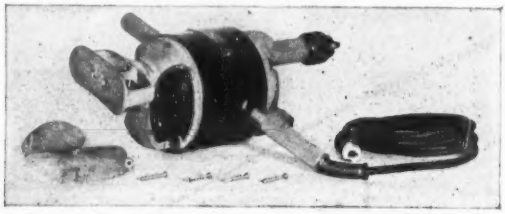
BELTED drives on steam or gas engine governors are often a source of much trouble owing to stretch of the belting and the spattering of oil upon its surface. The belting requires close attention, for if belt slip is permitted, the engine becomes irregular.



The William Tod Company has for several years employed machine cut chain and sprocket governor drives as a means of overcoming these difficulties. The arrangement of sprockets, shafting and bevel gears by means of which an absolutely positive speed ratio is maintained between main and governor shafts is clearly shown in the illustration.

This particular drive is also interesting as a part of the largest tandem compound engine ever built,—52 inch x 90 inch x 60 inch. This engine was made to drive a 43-inch three-high blooming mill in the Youngstown, Ohio, works of the Carnegie Steel Co. It is rated at 4,000 H. P., but delivers a peak load of 15,000 H. P., which is accomplished by means of a 24-foot flywheel weighing 120 tons. The engine is, of course, de-

pendent upon the governor for successful operation and the duty of the governor drive in steel mill work is unusually severe, owing to the sudden variation of load. Chain has proven to be the only drive that insures close governing and absolute dependability. In the illustration, the outboard bearing, flywheel, main shaft, driving sprockets and the chains are removed to show the governing mechanism better. The position of the chains in service is indicated by that of the chain guard. It will be noticed from the double driven sprocket and the width of the chain guard that two chains are used.



These are of the standard roller type similar to the ones used in automobile service and are made by the Diamond Chain & Manufacturing Co., Indianapolis, Ind. A single chain transmits sufficient power to drive the governor shaft, but the second chain is added so that one chain will always be working in case of an accident to the other. The chains, however, have never given trouble from any cause, and they require no attention save an occasional oiling.

Machined chain has met with considerable favor in many places where belting has failed. In driving milling machine feeds or parts of automatic machines where accurate timing is essential, chain is superior to belting. On slow and medium speed drives with short center distances, chain transmits practically all the power where a belt to do the same work would require a high initial tension. There being no possibility of slip with chain it can be run without initial tension, thus diminishing useless journal friction, the danger of hot boxes, the strain on shafting, and the amonut of lubricant required.

Alternating Current Portable Drill.

THE practice of taking heavy castings to a stationary drill, of spending much valuable time in adjusting them in order that a few brief moments may be spent in drilling is an instance of the wasteful methods that eat into the profits.

The direct current portable breast drill designed by the General Electric Company has met with great favor, and has so satisfactorily demonstrated its ability to do the work for which it was designed that they are now manufacturing an alternating current one, which possesses all the superior features of their direct current drill, and permits the use of this device where alternating current only is available. It possesses the ruggedness of design required to withstand the hard usage incidental to its service, yet its weight has been reduced to a minimum, being but 21 pounds, ensuring that the device may be handled by one person with great ease and rapidity. Two gnurled side handles and a breast plate provide ample means for holding it securely in any position. An indicating control switch for starting and stopping the motor is located conveniently near the right handle, so that it can be operated by the right hand without releasing the hold on the right handle. This feature makes control of the apparatus so simple that the whole attention may be given to the operation of the drill. Hand holes are provided, which furnish a means of easy access to the commutator and brushes for inspection and repairs

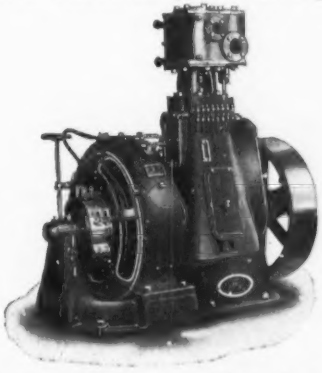
if necessary. The drill is fitted with a Jacob's chuck, which will take drills up to and including ⅜ inch in diameter. An idea of the great saving of time made possible by its use may be gained from the following approximate data: it will drill a ⅜-inch hole 1 inch deep in cast iron in 27 seconds; in machine steel in 95 seconds. It will also satisfactorily operate a ¾-inch wood bit.

Compare this with the time required to move heavy castings to a stationary drill, adjust them, drill one hole, adjust again, drill another, etc. In general a crane will be required, necessitating the services of several men in addition to the one operating the drill. In many cases the same work could be done in a few minutes by one person with a portable drill.

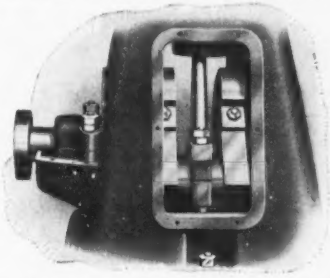
It is designed for operation on a 110 or 220 volt 60 cycle circuit, to which it is connected by screwing the attaching plug into a standard lamp socket.

A New Generating Set.

THE generating set described below is specially designed for use in isolated plants, upon shipboard, and in all places where a thoroughly reliable, high grade, efficient, quiet running generating set is necessary. It is the latest product of the B. F. Sturtevant Company, Hyde Park, Mass., who have been building engines and electrical appartus for a good



many years. The set consists of a generator of either the six or eight pole type, depending upon the size, attached to the same sub-base and direct connected to the new Sturtevant vertical single engine known as class VS-7. This engine is the result of over fifty years' experience in engine building, and in manufacturers claim that in this model they have retained the best and eliminated the objectionable features of their previous designs, and have also added many other details of construction which tend



to make a thoroughly high grade quiet running engine.

This engine is of the high speed enclosed type, the reciprocating parts being enclosed within the frame which is provided with openings through the front, back, and sides, of sufficient size and in just the right position to permit ready access for inspection or adjustment. These openings are fitted with dust proof covers which may be easily removed. A water shed partition prevents the oil from the frame being carried into the cylinder and the water in the cylinder being carried into the frame. This water shed partition together with a piston rod stuffing box, are located in a distance piece which separates the cylinder from the frame. Access to these parts is readily obtained through openings in the distance piece even though the engine is in operation.

The lubricating system, of the gravity type, consists of a reservoir cast in the top of the frame from which the oil flows to all bearings through piping equipped with sight feeds All the oil not used flows into a reservoir cast in the sub-base. It is filtered through fine screens and forced to the top reservoir by a durable, efficient, pump located in the sub-base and entirely submerged in the oil. The engine may be run independently of the oil pump by filling the

top reseroir through an opening provided in the frame and drawing off the excess oil from the bottom reservoir through a drain cock.

A Rites inertia governor placed in the balance wheel regulates the speed so accurately that the variation between no-load and full-load is not more than 1½ per cent.

The generator armature is of the iron clad, two circuit, ventilated drum type and is pressed upon the shaft. The armature coils are form wound and are thoroughly protected against oil and water. The commutator is made up of segments of pure, hard drawn copper insulated with amber mica of such hardness that it will wear uniformly with the copper. These segments are secured in a steel ring and insulated therefrom by rings of hard mica. Armature conductors, commutator segments and brushes are proportioned to give low current density, thus insuring low temperature rise, high efficiency and good operation. The brush rigging is arranged so that the brushes may be adjusted separately or may be adjusted simultaneously by revolving the brush ring.

The magnet frame is of cast iron and is divided on a horizontal plane. The pole pieces are of wrought iron and together with cast iron shoes are through bolted to the frame. The field coils are made up in two sections, the compound winding forming one section and the shunt winding the other section. They are machine wound and of open construction to secure maximum radiation and ventilation.

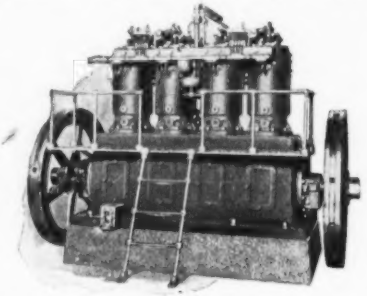
Only the best material obtainable and the most careful and expert workmanship enter into the construction of these sets which are thoroughly tested and subjected to the most rigid inspection before leaving the company's works.

Bulletins Nos. 171 and 172 describing these sets in detail may be had by addressing B. F. Sturtevant Company, Hyde Park, Mass.

The Merriam Gas Engine.

THE accompanying illustration shows an elevation and section of the Merriam gas engine built by the Bruce-Macbeth Engine Co., Cleveland, Ohio, successors to the Bruce-Merriam-Abbott Co. and the Macbeth Iron Co.

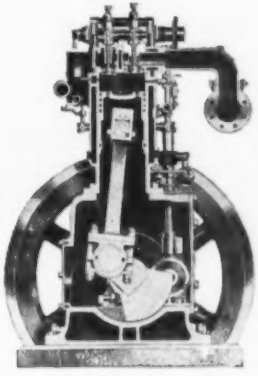
The cylinders are completely water-jacketed and cast separately. Each is



bored to an accuracy of a thousandth of an inch and micrometer dimensions taken and stamped on the upper edge. They are supported on the crank chamber by heavy flanges, reinforced with extra strong ribs, cast integrally with the cylinders. This construction is heavier than is usually found in such engines, and makes the cylinders absolutely rigid and free from vibration at all times. The piston is of the trunk type, and made extra long, providing for minimum wear and greatly prolonging its life. It is fitted with five snap rings made from cast iron and machined eccentric to insure uniform strength and perfect fit to the cylinder, thus giving absolute compression and assuring maximum efficiency and allowing the engine to be subjected to heavy overload. The crank chamber consists of a heavy casting thoroughly ribbed and accurately planed for the support of the cylinders. It is bored throughout its entire length at one setting, thus providing perfect alignment of crank shaft bearings. The crank chamber is easily accessible through cover plates at the front and doors in the rear to permit inspection

and adjustment of the crank shaft and connecting rod bearings.

The valve stem is so designed as to eliminate the use of thread and nut, in place of which steel blocks are used. These blocks are machined to fit the square portion of the valve stem. The exhaust valve is water-cooled, thus preventing overheating and insuring perfect lubrication. The air port is below the gas port and the valve is so made



that a portion of air enters the cylinder in advance of the mixture of gas and air. This prevents back firing.

The characteristic prominent in the construction of the Merriam engine is the unit design of the operating mechanism. The operating unit opens and closes the inlet and the exhaust valves and operates the ignition mechanism. The unit consists of a cam shaft made from a high carbon steel forging on which the cams are machined, each in its proper position, so that when the valves are properly adjusted there is no possibility of any change due to the cams slipping. The cams act on rocker arms, fitted with set screws for the adjustment of the valves, and the rocker arms are equipped with cam rollers operating on hardened steel bearings. This construction eliminates the use of push rods and other moving parts and consequent wear and noisy operation. The operating unit is driven from the governor shaft through a pair of steel bevel gears and the igniter contact cam and distributor is mounted on the forward end of the cam shaft. The advantage obtained by this unit method of design is that all parts of the operating mechanism are easily accessible for inspection and cleaning. Positive and practically noiseless operation is assured and the entire mechanism can be removed from the engine without dismantling other parts.

The governor is of the centrifugal ball type mounted on a steel shaft supporting and driving governor balls, which control the engine speed. The entire governor mechanism is easily removable from the engine without disturbing other parts. The design of the governor weights and springs is worked out to assure perfect regulation of engine speed and high economy in fuel consumption under all working loads.

The ignition apparatus consists of two complete and independent systems, each supplying a separate spark. Each cylinder therefore receives two sparks at the proper time, either one of which is sufficient to cause combustion. The distributor consists of a timer constructed with hardened steel cam mounted on the forward end of the cam shaft in the operating unit. The purpose of this cam is to make and break a contact between two copper pins submerged in a bath of kerosene oil held in a cup attached to the timer. The sparks produced by this apparatus are distributed to the proper cylinders through cables supported by hard rubber blocks.

The splash feed system of lubrication is employed and a liberal amount of oil is carried in the bottom of the crank chamber, the exact amount of which is visible through a plate glass cover. The engines are started by compressed air.

The Bruce-Macbeth Engine Co., Cleveland, Ohio, have just published a well-illustrated catalogue showing the several parts in detail and giving much other information, which they will send to inquirers on request.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Expansion Bolts.

STAR EXPANSION BOLT CO., 147 Cedar Street, New York City.—Descriptive catalogue of "Star" expansion bolts, single and double expansion, for use with machine bolts and screws, wood screws, or lag screws, for attaching securely to metal, stone, brick-work, concrete, wood, etc.

Feed-Water Filter.

AMERICAN STEAM GAUGE & VALVE MFG. CO., Boston, Mass.—Description of the American H_2O grease extracting feed-water filter for marine and stationary engines.

Fuel Economizers.

B. F. STURTEVANT CO., Hyde Park, Mass.—Catalogue No. 150, describing Sturtevant fuel economizers and air heaters This type of economizer with all joints metal-to-metal will stand working pressures up to 300 pounds per square inch, and the doing away with gasket joints eliminates chance of leakage. A new design positive scraper mechanism prevents sticking of the scraper, which eliminates one of the troubles found in earlier designs of economizers.

Gauges.

SCHAEFFER & BUDENBERG MFG. CO., Brooklyn, N. Y.—An extensive catalogue on pressure and vacuum gauges, and instruments of precision for measuring pressure, temperature and speed. An interesting instrument shown is the draught gauge for measuring the draught in flues of steam boilers. The influence of the chimney upon the working and economy of a steam-power plant is a factor of the greatest importance. Its functions are to furnish sufficient draught properly to burn the fuel and to carry off the products of combustion. This gauge is of very simple construction and not liable to derangement. It is fitted with a large and easily read dial, usually graduated to one inch, and readings in hundredths of an inch can be taken.

Graphite Lubrication.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.—A booklet entitled "Graphite as a Lubricant." This eleventh edition is more compact than its predecessor, the idea being to concentrate information in convenient form. It deals particularly with the lubrication and treatment of power-house requirements.

Lubricator.

DETROIT LUBRICATOR CO., Detroit, Mich. —A booklet illustrating the Detroit bulls-eye locomotive lubricator, and containing full descriptions of the various types and sizes, together with information relative to installation, operation, care, etc.

Portable Elevator.

N. Y. REVOLVING PORTABLE ELEVATOR CO., Jersey City, N. J.—Descriptive catalogue of a revolving portable elevator intended for use in warehouses, factories, mills, storehouses, or other places where boxes, barrels, bales, cases, etc., are handled. Moves objects weighing up to 1,200 pounds and raises them to any required height up to 10 feet. It makes possible the use of all the storage space in a warehouse or other building without the tremendous physical labor necessary in hoisting or tiering boxes, barrels, or bales in the usual way. The upper part can be folded over to pass through low doorways.

Pulleys.

ONEIDA STEEL PULLEY CO., Oneida, N. Y. —Folder showing a variety of styles of Oneida pulleys, indicating the construction from the smallest to the largest sizes. The details are carefully brought out and the distinctive and characteristic features are strikingly evident. These pulleys are from one-quarter to one-third as heavy as cast-iron pulleys.

Sheet Steel.

BROWN HOISTING MACHINERY CO., Cleveland, Ohio.—A descriptive circular of Ferro-Inclave, a sheet steel with dovetail corrugations, which are inversely tapered, thus permitting the large ends of the corrugations of one sheet to fit over the small ends of the corrugations of another sheet, forming a tight joint without destroying the dovetail of the corrugations, and making practically one continuous sheet Used as reinforcement for concrete roofs, floors, sidewalls, partitions, stairs, coal-bins, highway bridges, culverts, tanks, silos, etc.

Vanadium Steels.

AMERICAN VANADIUM CO., 316 Frick Building, Pittsburg, Pa.—A most interesting monograph on vanadium steels, their classification and heat treatment, with directions for the application of vanadium to steel and iron.

Water Softener.

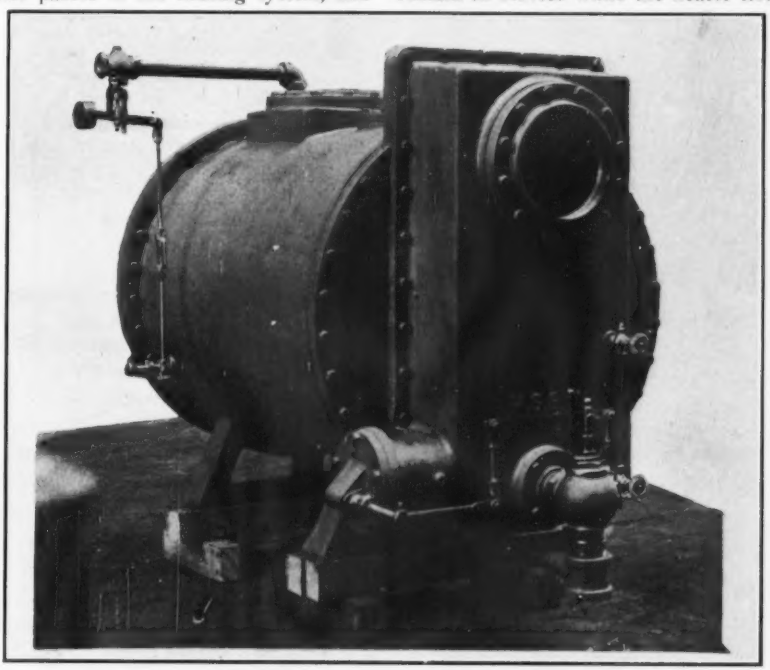
L. M. BOOTH CO., 136 Liberty Street, New York City.—A handsome booklet illustrating in detail the Type "F" Booth water softener. It is assumed that the reader is familiar with the loss and damage resulting from the use of hard water, and the benefits and savings obtained by using clear soft water for all purposes are not referred to.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Compact Feed Water Heaters and Receivers.

AMONG the most essential parts of an exhaust steam heating system are the oil separator to remove cylinder oil from the exhaust steam before the latter passes to the heating system, and a receiver or return tank to which the condensate can be brought back before being pumped into the boiler. This tank usually takes the form of an open feed water heater, and part of the exhaust steam is used for reheating the returns to about 210 degrees F., before they are pumped into the boiler.

Recently the Harrison Safety Boiler Works, 3138 N. 17th Street, Philadelphia, Pa., have brought out an improved type of heater and receiver, combined with an extra large separator and fitted with valves so that the separator can remain in service while the heater itself is out of circuit for inspection or cleaning. This combined apparatus replaces a considerable amount of apparatus, and saves a corresponding amount of space in boiler rooms, which is important in large office and other buildings. Frequently, however, there is not headroom enough for the upright rectangular type



of heater and receiver, in which case the horizontal, cylindrical form, fitted with the surplus exhaust or steam stack type of separator, shown herewith, is made.

The apparatus is peculiar in that the steam stack is not at the top of the separator, as ordinarily is the case, but from the side, still further reducing the amount of headroom required. The separator covers the whole end of the heater, or rather the separator and the drainage trap which disposes of the drips from the separator and of the overflow from the heater are both contained within the ring casting at the end of the heater, the shell of the heater being constructed something like that of a cylindrical surface condenser. A circular plate closes the end of the heater body proper and contains the port through which the steam enters the heater and the opening through which the waste from the heater overflow or skimming weir escapes into the trap. The separator ring is bolted fast against the plate. At one side of the separator casting is the surplus exhaust outlet, and below is the stuffing box for the lever to which is attached the float that operates the valve draining the trap.

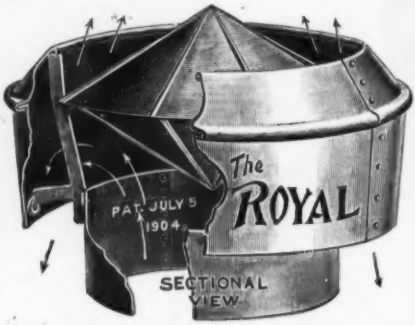
Two semi-cylindrical valves on a common spindle serve to close the steam opening simultaneously, and thus to shut the separator off from the body of the heater when the latter is to be opened for cleaning or inspection while the heating system remains in operation. At the top of the spindle is a handle swinging horizontally over the top of the heater shell. The separator baffle plate, which serves to arrest the particles of oil and moisture carried by the current of exhaust steam entering the separator, is attached to the front cover plate of the separator, the steam passing around one side and then behind the baffle. When the steam valve is open, the steam deflected into the heater, that is, the heater receives "preference," the remainder of the exhaust steam passing to the surplus exhaust outlet.

At the opposite end of the heater shell are the cold water inlet and the float mechanism controlling the same according to the level of the water in the heater. The opening for gravity returns is also at this end, as is the door for removing the trays over which the water is sprayed in the top of the heater, and the door for removing precipitated impurities and filtering material from the bottom part of the settling chamber.

However, the principal feature of interest about this heater is the use to which it has been put. It is installed between a steam engine and an absorption refrigerating machine, purifying of oil the exhaust steam passing to the refrigerating machine and receiving the condensed returns from the latter and such make-up water as may be required, and heating the same up to 210 degrees F. for boiler feed. In order to be able to operate the ammonia generator at any desired pressure, the heater has been made with a solid shell to withstand a maximum pressure of 40 pounds.

The "Royal" Ventilator.

THE proper ventilation of a workshop not only has an important bearing on the health of the employee, but it has been shown by numerous tests that it bears equally on the quantity and quality of the output. Men who work in fresh, invigorating air turn out more work of better quality than men who labor under the depressing influence of vitiated air. The matter of supplying a factory, shop or office with a sufficient



quantity of fresh air is a matter of even more importance than the architecture of the building. The average man requires about 30 cubic feet of fresh air a minute, or 1,800 cubic feet an hour. It is plain, therefore, that unless proper provision is made for the constant renewal of the air in the shop it is but a question of a short time when the employees are working under the stupefying effects of bad air, and the result is shown in reduced output and less lively interest in the quality of the product.

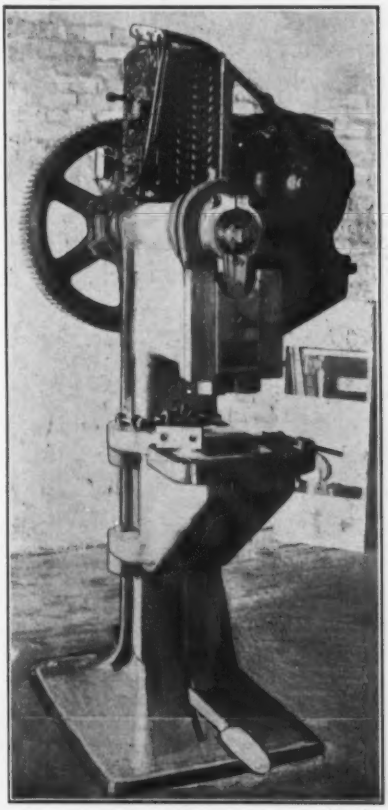
The accompanying illustration shows the construction of the "Royal" ventilator. Just as the savage sharpens the ends of his arrows so that they will present less resistance to the air, so in the Royal the cone is sharpened on the bottom, to offer less resistance to the rush of air outward. Thus it offers the least resistance to natural or forced draft, ventilates better, more quickly, and with no back draft.

"Ventilation by the Royal System" is the title of a pamphlet on the ventilation of factories, shops, offices, public buildings, etc., published by the Royal Ventilator & Manufacturing Co., 434 Locust Street, Philadelphia. They will send a copy to any one making request for it.

Motor Driven Punch Presses.

THE old dark punch-shop, with its lines of overhead shafts and belts, has disappeared from the modern factory with the advent of individual motor drive. As its successor, there has been left a clean, well-lighted apartment, free from ceiling obstructions, and having each machine separately driven by its own self-contained motor. One of the most important operating results of this change has been the reduction in running costs. In order to operate a single machine, it no longer becomes necessary to incur the transmission and friction losses of the whole shop. Each press is started and controlled from the switch and rheostat mounted on its frame or in a nearby position. The mechanical connection from the motor to the crank shaft is made directly and efficiently by spur or chain gearing, giving a suitable speed reduction with a minimum number of parts.

The accompanying photograph shows one of several motor-driven stamping presses for making metal boxes, installed in the factory of the Eclipse Box Manufacturing Company, Grand Rapids, Michigan. The press shown is a Toledo deep-gap press used for riveting steel frames for metal-bound wood boxes, and for riveting together the steel parts for all metal or metal-bound wood boxes. The drive is by means of a 2 H.P. 250 volt Westinghouse type "S" motor, running at 775 R.P.M., and geared to the shaft from which the punch eccentric is operated.



The demand for individually driven presses has been growing for several years, and at the present time the manufacturer is furnishing a greater number of machines fitted with this modern form of electrical operation than ever before.

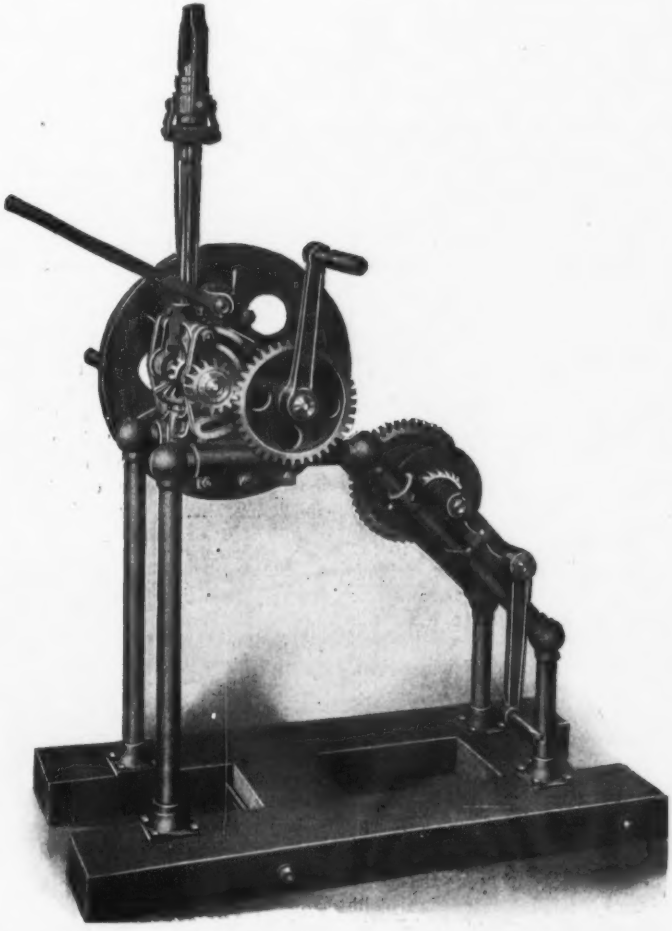
Measuring Speeds by Electricity.

THE speed of a vehicle or machine is an important factor in its economy, hence the apparatus necessary in the art of measuring speed has deservedly received of late much attention. The Hutchison electrical tachometer is the latest contribution of an American engineer to engineering economy. Tachometers in general use, such as the Horn type, are operated by centrifugal force similar to the engine governor. Difficulties of transmitting motion necessitates the location of the instrument in close proximity to the shaft the speed of which it is to measure. The Hutchison tachometer has no such limitations. It is capable of indicating speeds at remote points and a plurality of remote points at that. Essentially, it consists of a magneto of the inductor type driven by the rotating shaft, the speed of which is to be measured. The voltage thus generated is proportional to the speed and may be indicated in R.P.M. on a properly calibrated voltmeter, or voltmeters, located wherever desired and wired to the magneto. The use of the inductor type magneto obviates collector rings, brushes or any contacts, the resistance of which might change. In fact, every joint from the magneto to the voltmeters is soldered and taped. The current required for the operation of the voltmeters or indicators is minute. It seems that the electrical design of the system has inherently overcome difficulties that have proven insurmountable in D. C. systems. Many novel mechanical features bear witness to the ingenuity of those who have been developing this electrical tachometer for the past two years.

The marine type, the first to be put into commercial service, is illustrated herewith. Rotation of the shaft is imparted to the driving sprocket by the chain. The smaller sprocket is loose, not keyed to the generator shaft, but is simply rotatively mounted thereon. Two oppositely coiled flat spiral springs transmit the rotation of the sprocket to the flywheel, which is keyed onto the shaft, one end of each spring being attached to the sprocket, and the other end to the flywheel. Any irregularity, therefore, or rotation, caused by variations

in angular velocity of the shaft, is smoothed out by the spiral springs, so that the rotation imparted to the flywheel is a constant resultant speed.

This form of tachometer is made by the Industrial Instrument Co., Foxboro, Mass., who will furnish information about them on request.



Hand Power Core Drill.

THE Terry Core Drill Company of No. 50 Church Street, New York City, have recently placed on the market a hand power core drill which is designed for prospecting, foundation testing and for making wash borings. To determine, without washing, the character of soils or mineralized sand, special tools are provided with which "dry samples" can be obtained. This method of testing, particularly in placer deposits, is important, as the exact formation can be at once determined, whereas, by the washing process, the heavy or mineralized particles will not always wash to

the surface. They claim that the design of this drill is unique, as they have equipped it with a flywheel, which insures a uniform speed of the drill tools with the least exertion. This is an improvement which has not previously been taken advantage of in hand power drills. Furthermore, the drill has unusually long bearings for the spindle, which is a feature of all the drills designed by this company. These long bearings impart a steady motion to the drill rods, and prevents their lashing in the bore hole, thereby avoiding unnecessary breakage of the cores, increasing the speed of drilling, and the percentage of core which is recovered.

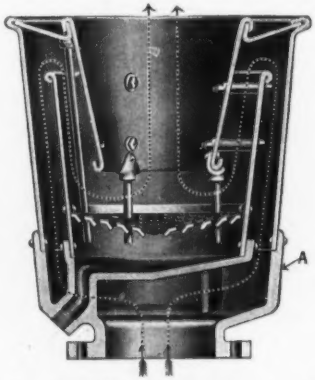
The capacity of this drill is 300 feet, to which depth it will bore a 2¼ inch hole and cut a 1¼ inch core. Either diamond or shot tools can be used. For mountainous countries, inaccessible to larger apparatus, and where fuel is difficult to obtain, it is particularly adapted. The shipping weight is 415 pounds, and the heaviest single piece, (the flywheel), weighs 73 pounds. When knocked down it may be readily transported from place to place, and can be quickly assembled for operation.

The drill driving shaft is provided with change gears so that fast or slow speed may be obtained according to the character of the material to be drilled. The head swivels to any angle, and can be slid back on its frame to clear the bore hole when raising or lowering the drill rods or when casing is being driven. A sensitive feeding device is used, which consists of a double drum with ropes extending to the water swivel and to which pressure is applied by a lever with a ratchet and pawl. Mounted on the rear of the drill frame is a hand hoist used for raising or lowering the drill rods and for driving casing through soil to bed rock. The frame, supporting both the drill head and hoist, is of seamless cold drawn tubing, light in weight, yet of sufficient strength to withstand the heaviest load which may be placed upon it for its rated capacity. Cut gears and phosphor bronze bearings are employed throughout, and all working parts are carefully and accurately machined so that friction is reduced to the minimum. A hand force pump is used, which supplies water to the bore hole.

For drilling operations more extensive than a hand machine is capable of undertaking, and when portability is essential to the work, a power attachment can be applied to this drill by substituting a pulley for the flywheel and a countershaft with a friction clutch to control the power. When so arranged it can be driven with steam, gasolene or horse power. The friction clutch is advantageous when a gasolene engine is used, as it eliminates the annoyance of stopping and starting the engine while the drill may be momentarily stopped. When equipped to operate with power it is capable of boring a 2¼ inch hole to a depth of 400 feet.

"Neverust" Exhaust Head.

THE Neverust exhaust head, illustrated herewith, is designed to be made entirely of copper and cast iron and as a substitute for cast iron heads. By making it larger and of heavy gauge copper its efficiency can be increased over cast heads, its weight made less



and its durability in no way impaired. On account of the less weight of the copper and the small amount of labor required in construction, it can be sold at a reasonable price.

The steam in passing through the head takes the course indicated by the dotted lines. The base of the head is extended upward at A, so that the steam current will never cut it away at this point, as might be the case if of thinner metal. At the top the steam has expanded, so there is not this tendency.

It will be noticed that the cone, which takes the blow from the steam, and the base of head are of one piece and a substantial casting. The top of the head is arranged so that any water settling upon it drains to the lowest point and through a pipe to the water chamber and from there out of the head. In times of storm this flushes this part of the head, and since the passage to the drain is very large, no cleaning is necessary.

Being made only of copper and cast iron the durability of the head is assured, and its efficiency is guaranteed.

Further information may be had from Franklin Williams, 39 Cortlandt Street, New York.

New Safety Cutter Head.

ANY improvement in a machine which will increase the safety of the operator is surely of value, providing of course that the efficiency of the machine is not lessened by the change. In a woodworking shop the hand planer is probably the most dangerous of any machine tool, and the statement has been made that more fingers have been lost in hand planers than by any other single type of tool. A new cutter head for hand planers and jointers, which assures maximum safety to the operator by reason of its permitting the tables to be set very close together, has lately been introduced in the woodworking machine tools manufactured by the J. A. Fay & Egan Co., 212-232 W. Front Street, Cincinnati, Ohio. In the old style cutter head with the square block and knives bolted to its sides, the square shape of the block would neither permit the tables to be set close together nor did the head itself fill the opening between the tables. Thus with the slightest slip on the part of the operator his fingers might be drawn in between the tables and badly mutilated, if not lost.

The new safety circular cutter head closely fills the opening between the tables so that the most severe accident that could possibly happen would be the scraping of a finger or thumb. The new head is made from a solid piece of crucible steel, which is first roughed on a lathe to the desired circumference and then ground accurately to size. Afterward seats for the two knives are milled

into the steel body. High-duty tungsten steel knives are used on this cutter head and are held in the milled slots by special blocking, which is wedged against them by sets of cup-head clamp screws. The design is such that the cutting edges of the knives protrude but slightly from the circumference of the cylindrical-shaped head and thus permit the tables to be set very close to the cutter.

The illustration herewith shows this new circular cutter-head in machine with the tables drawn back, giving the reader an idea of its construction

Catalogue No. 81 issued by the manufacturers describes this safety cutter head in detail, and will be sent on request.

"Vulcan" Auto Tool.

CONVENIENCE, service and wear are assured by the manufacturer of this ingenious contrivance, J. H. Williams & Co., Brooklyn, N. Y. They denominate it "a pocket tool" chest, each one of the twelve features replacing a dozen ordinary tools. Its usefulness and efficiency extend beyond the automobile to the motor boat, the household, etc.

The tool is drop-forged from selected steel, milled and ground to correct sizes of openings, tempered, polished and blued. It comprises the following tools: 1, a hammer; 2, tire lug wrench; 3, cotter pin puller; 4, gas tank wrench; 5, wire insulation scraper; 6, air tank wrench; 7, spark plug wrench; 8, alligator wrench; 9, cotter pin spreader; 10 and 11, screw drivers; and 12, bottle opener.

Industrial Notes.

—Buff & Buff Mfg. Co., Jamaica Plain, Boston, Mass., have opened a branch office at 50 Church street, Hudson Terminal Building, New York City. They show there their latest models and designs of civil engineering instruments, transits, and levels,—especially for subway, tunnel, and wet mine work, which completely prevents the entry of water and moisture into any of the bearings.

—The Harrison Engineering Co., 42 East 23d street, New York City, has been awarded the contract for the installation of the heating and ventilating system for the Lincoln School, of Westwood, N. J., after consideration of hot blast and hot air furnace systems. The Harrison air tube heater system comprises a new type of hot air furnace arranged for use with a fan for positive ventilation.

—The Phillipsdale Paper Mills, of Phillipsdale, R. I., are to install at once two 250 H. P. Stirling boilers, each of which will be equipped with a 3-retort Taylor gravity underfeed stoker. This order for Taylor stokers is the second received from these mills; the total boiler horse power equipped with these stokers will be 1,700.

—The importance attained by the Middle West as a manufacturing center is indicated by the increasing number of western concerns that have found it necessary to establish eastern branch factories. The latest of the more important concerns to do this is the Cutler-Hammer Mfg. Co., whose plant in Milwaukee, is the largest in the world devoted exclusively to the manufacture of electric controlling devices. This company has just completed the erection of a new factory in New York City, the building being five stories in height, containing about 100,000 square feet of floor space and is of steel and brick construction throughout. The substantial construction of the building itself, the excellent light afforded by reason of its location on three streets and the complete electrical equipment for light and power make the eastern plant of the company unquestionably one of the finest factory buildings in New York City.

New Almond Geared Chuck.

THIRTY years' study in the art of manufacturing ideal drill chucks has developed the new Almond geared chuck, from a practical standpoint a decided innovation, with features that prove its individuality and economical value to the user.

The broadest departure has been the cutting of the gear teeth on the nut or split ring (operating the jaws) which

is made of hardened, tempered tool steel. The advantages consequent from this may be readily comprehended by those who have had experience with chucks with teeth cut on the knurled sleeve, which depreciate in value to the user, for after being taken apart several times for cleaning, the ferrule becomes stretched from being forced on and off, with the resultant disadvantage of having it frequently slip on the nut.

Another feature is pinions that do not break, making replacements unnecessary and including for convenience sake, interchangeable pinions, so that one pinion may be used on both types of the Almond chucks, now manufactured.

The nut has been increased in diameter to permit forming the teeth on the front side of the nut. The thrust-bearing area, which withstands the pressure when the jaws are forced out to grip a tool, has also been increased two-fold, permitting greater pressure on this surface and the retention of the lubricant for a much longer period.

The makers are T. R. Almond Mfg. Co., 8 Maple Avenue, Ashburnham, Mass., who will send complete information on request.

Reinforced Waterproofing Felt.

THE Barrett Manufacturing Co., 17 Battery Place, New York, have introduced a reinforced waterproofing felt which they name "Tartex." It is made of "Barrett Specification" felt reinforced by being united with a strong, closely woven cotton drilling, thus giving it a tensile strength greater than any other material used in waterproofing, and it will unite perfectly with "Barrett Specification" pitch. It is unusually pliable, and is especially adapted for use where the application of material is difficult and where laps must be exposed while other work is in progress. Samples will be sent on request to engineers, contractors, architects and others who may be interested in such a material.

Industrial Notes.

—Dodge & Day, engineers, Philadelphia, have just completed a commission aggregating the expenditure of $400,000 for new buildings and improvements for the Warner Brothers Company at Bridgeport, Conn. Last March they were retained to make a study of the existing conditions and co-operate with Warner Brothers in the determination of the amount of space, the amount of expenditure and other considerations that would enter into the contemplated increase. After several weeks of preliminary study, the report was approved by Warner Brothers and they were commissioned to prepare detailed plans and specifications and to let contracts covering the construction of three large new buildings and one large central power plant, and give special attention to heating, ventilating and fire protection. The preliminary work was begun last March and by January 1, 1910, the buildings,

including additions and alterations to the existing plant, were entirely completed. During the process of construction and moving, the entire method of power transmission was changed to the electric drive and all departments are now served by the power plant already referred to.

—Mr. A. Falkenau, formerly president of the Falkenau-Sinclair Machine Co., Philadelphia, has associated himself with Mr. George K. Hooper, industrial engineer, 165 Broadway, New York.

—Mr. C. V. Kerr, chief engineer of the Kerr Turbine Co., Wellsville, N. Y., has resigned his position with this company. The development of a centrifugal pump and other lines of mechanical devices will receive Mr. Kerr's specific attention under patents which he holds. Mr. J. L. Moore, chief designer, will succeed to the office of chief engineer.

—The Pierce Phosphate Company is installing a Westinghouse gas engine driven alternator set in its new generating station at Pierce, Fla., to serve as an auxiliary to the old power plant. The new equipment consists of a 1,150 horsepower Westinghouse single crank horizontal gas engine, with cylinder 34 by 42 inches, direct connected to a 850 kilowatt ampere Westinghouse alternating current generator, supplying three-phase power at 2,300 volts, for hydraulic mining work. The engine is furnished with fuel gas from double zone producers, having a calorific value of 110 B.t.u. per cubic foot. The new addition to the power plant equipment represents an expenditure of about $75,000, and will operate in parallel with the old station, built some six years ago, which contains six 200 horsepower Diesel gas engines driving 150 kilowatt alternators.

—Mr. F. A. Hall, who for the past twelve years has been manager of the chain block and hoist department of the Yale & Towne Mfg. Co., Stamford, Conn., has resigned his position in order to accept election as vice-president and treasurer of the Cameron Engineering Co., of Brooklyn, N. Y. Mr. Hall's successor will be Mr. R. T. Hodgkins, who for several years has been his chief assistant.

—Mr. Charles T. Mair, engineer, has moved his offices to the new Boston Safe Deposit & Trust Co., Boston, where he will continue to make a specialty of textile mills and other industrial plants, water and steam power development, and examinations and reports on plants with reference to their value, reorganization and development.

—The Wagner Electric Manufacturing Company of St. Louis announce the opening of a district office in Detroit in the Union Trust Building, in charge of Mr. A. B. Hoffman.

—The Bruce-Macbeth Engine Company, of Cleveland, builders of two and four cylinder vertical gas engines, have opened a branch office in Philadelphia at No. 1020 Drexel Building. This office will be in charge of M. E. Jackson, who will be prepared to furnish complete information relative to gas engines, producers and complete gas power plants. This territory offers a particularly attractive field for gas power installations on account of the high cost of steam and central station power, and the Bruce-Macbeth Engine Company found it necessary to open this branch office to handle its rapidly increasing business.

—L. H. Thullen has recently become chief engineer of the Triumph Electric Company, Cincinnati. Mr. Thullen is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers.

—P. M. Haight, treasurer of the Sprague Electric Company, was recently elected President of the Electrical Trades Society of New York.

—The Raymond Concrete Pile Company, of New York and Chicago, has been awarded the contract for placing the concrete piles in the foundations of the new City Hall at Des Moines, Iowa.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Ball Bearings.

INTERNATIONAL ENGINEERING CO., New York.—Extensive catalogue of radial and thrust ball bearings for automobiles, motor boats, electrical machinery, and all other engineering applications.

Belting.

BOSTON BELTING CO., Boston, Mass.—A booklet describing gutta-balata belting. Made of a very heavy duck, closely woven from hard twisted, long staple cotton yarns. This duck is treated and then impregnated and coated with gutta-balata compound. The duck thus prepared is cut and folded so as to make what appears to be two separate belts of the same width, although not necessarily of the same number of plies or thicknesses. The side of each separate belt having the selvages of the duck is next given a special coating. The two belts are then united in such a way that the bond between them is not only equal in strength but actually stronger than between any other plies in the belt. The seams or joints in the duck are in the interior of the belt.

Chucking Grinder.

BRYANT CHUCKING GRINDER CO., Springfield, Vt.—A grinding machine for that part of lathe work known as chuck work, adapted to both outside and inside grinding.

Core Drills.

TERRY CORE DRILL CO., 42 Church Street, New York City.—A very well illustrated catalogue of the cored drills and accessories for prospecting, testing, blasting, etc.

Exhaust Fans.

AMERICAN BLOWER CO., Detroit, Mich.—Bulletins Nos. 271 and 272, illustrating the Type V and Dixie exhaust fans.

Fans.

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—Besides giving tables of pressure, velocity, horse power, etc., necessary for moving air, this publication also goes into the discussion of efficiency and cost of operation, as compared to the first cost of fans, takes up the various methods of construction and balancing, and points out the necessity of having each fan suited to the particular requirements of an installation.

Furnaces.

ROCKWELL FURNACE CO., 26 Cortlandt Street, New York City.—Bulletin G, describing annealing, hardening, and tempering furnaces for case hardening, annealing and tempering as applied to the making of tools, dies, taps, punches, cutters, screws, springs, machine parts, sheet-metal stampings, etc., requiring uniformity. No chimney is required.

Gas Engines.

NEW YORK ENGINE CO., 165 Broadway, New York City. A thoroughly illustrated catalogue illustrating gas engines and gas producers made by this company.

Jet Condensers.

WHEELER CONDENSER & ENGINEERING CO., West Street Building, New York.—Booklet entitled "A Radical Improvement in Jet Condensers," describing a jet condenser giving a vacuum of 28.75 inches of mercury, which is so designed that a thorough mixture of exhaust steam and cooling water takes place and at the same time the air present is prevented from pocketing, and is delivered to the air pump at a minimum temperature.

Milling Machines.

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio.—An extensive catalogue showing a complete line of milling machines, both cone type and high power or single pulley. The latter form is shown in two styles, horizontal (plain and universal) and vertical. There is included a large number of milling machine attachments that can be supplied with these machines.

Mine Locomotives.

JEFFREY MFG. CO., Columbus, Ohio.—Bulletin No. 17, illustrating and describing Jeffrey electric mine locomotives, designed with special regard to the exact proportions, strengths, and disposition of parts to produce machines of maximum capacity under the extremely limiting conditions which obtain in mine practice.

Oil-Fuel Burners.

HAUCK MFG. CO., 140 Cedar Street, New York City.—Pamphlet describing Hauck portable burners for producing an intense heat for welding and straightening and preheating broken parts preparatory to welding by the autogenous, thermit, or similar process. They are designed for use in boiler shops, machine shops, for structural work, forge and railway shops, and shipyards.

Oil Pump.

MANZEL BROTHERS CO., 315 Babcock Street, Buffalo, N. Y.—A booklet describing the Manzel improved forced and sight-feed oil pumps for cylinder lubrication.

Open-Hearth Steel.

HARBISON-WALKER REFRACTORIES, CO., Pittsburg, Pa.—A book entitled "A Study

of the Open Hearth," being a treatise on the open-hearth furnace and the manufacture of open-hearth steel. Its aim is to put into concise form the principles involved, together with such detailed description as may render the subject matter plain to one familiar with no more than the most elementary principles of chemistry and metallurgy.

Oxhydric Welding.

AMERICAN OXHYDRIC CO., Milwaukee, Wisconsin.—Booklet describing the oxhydric process for the cutting and welding of metals by the oxhydric torch as patented by the Société L'Oxhydrique Internationale.

Pulleys.

ONEIDA STEEL PULLEY CO., Oneida, N. Y.—This is a very handsomely illustrated and remarkably complete catalogue of Oneida pulleys. These pulleys can be built for any load or speed; nor in the construction are they restricted to the common sizes of diameter face, width, and bore. They are built in the largest range of sizes and styles, and include such specialties as belt and conveyor pulleys, drums, elevator, head, tail and tripper pulleys, flange pulleys, etc. This advantage make is possible to supply and equip a factory throughout with one make of pulleys. The regular sizes run from 6" to 126" in diameter, 2" to 40" face, with hubs to fit any standard shaft from 1" to 18". On special orders they are made in odd diameters such as 25", 27", 29", etc. This makes it possible to drive machinery at any exact speed desired, and thereby to obtain the maximum output of the machine.

Pumps.

AMERICAN WELL WORKS, Aurora, Ill.—Report on the result of certain efficiency tests of centrifugal pumps. Many interesting tables and curves are appended.

Pulverizer.

INDUSTRIAL SUPPLY & EQUIPMENT CO., 407 Sansom Street, Philadelphia, Pa.—Illustrated pamphlet describing the working parts of the Benjamin pulverizer.

Screens.

JEFFREY MFG. CO., Columbus, Ohio.—Catalogue No. 69-B, illustrating and describing very thoroughly Jeffrey revolving screens.

Spiral Riveted Pipe.

AMERICAN SPIRAL PIPE WORKS, Chicago, Ill.—Pamphlet illustrating a number of installations of Taylor's spiral riveted steel pipe, showing some of the different purposes for which this pipe is especially adapted.

Steam Hammers.

CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.—Pamphlet showing an extensive line of steam and drop hammers and hydraulic machinery.

Steel Sash.

DETROIT STEEL PRODUCTS CO., Detroit, Mich.—A well-illustrated portfolio showing many views of structural steel sash for use in warehouses, factories, mills, foundries, car shops, power stations, garages, institutions and all industrial buildings, and for interior partitions and elevator enclosures. Detailed drawings and photographic illustrations are numerous.

Steam Trap.

KITTS MFG. CO., Oswego, N. Y.—A handsomely illustrated catalogue describing in detail the Kitts steam traps, reducing valves, pump governors, fan engine regulators, damper regulators, safety feed water regulators.

Steam Turbine Generators.

KERR TURBINE CO., Wellsville, N. Y.—Bulletin illustrating turbo-generator sets for electric power and lighting and pumping units for boiler feeding, fire service, water supply, circulating condenser water, draining pumps, and for other service where water must be delivered at moderate or high pressure or against considerable head. Contains interesting descriptive matter about the construction and operation of Kerr steam turbines.

Steam Turbines.

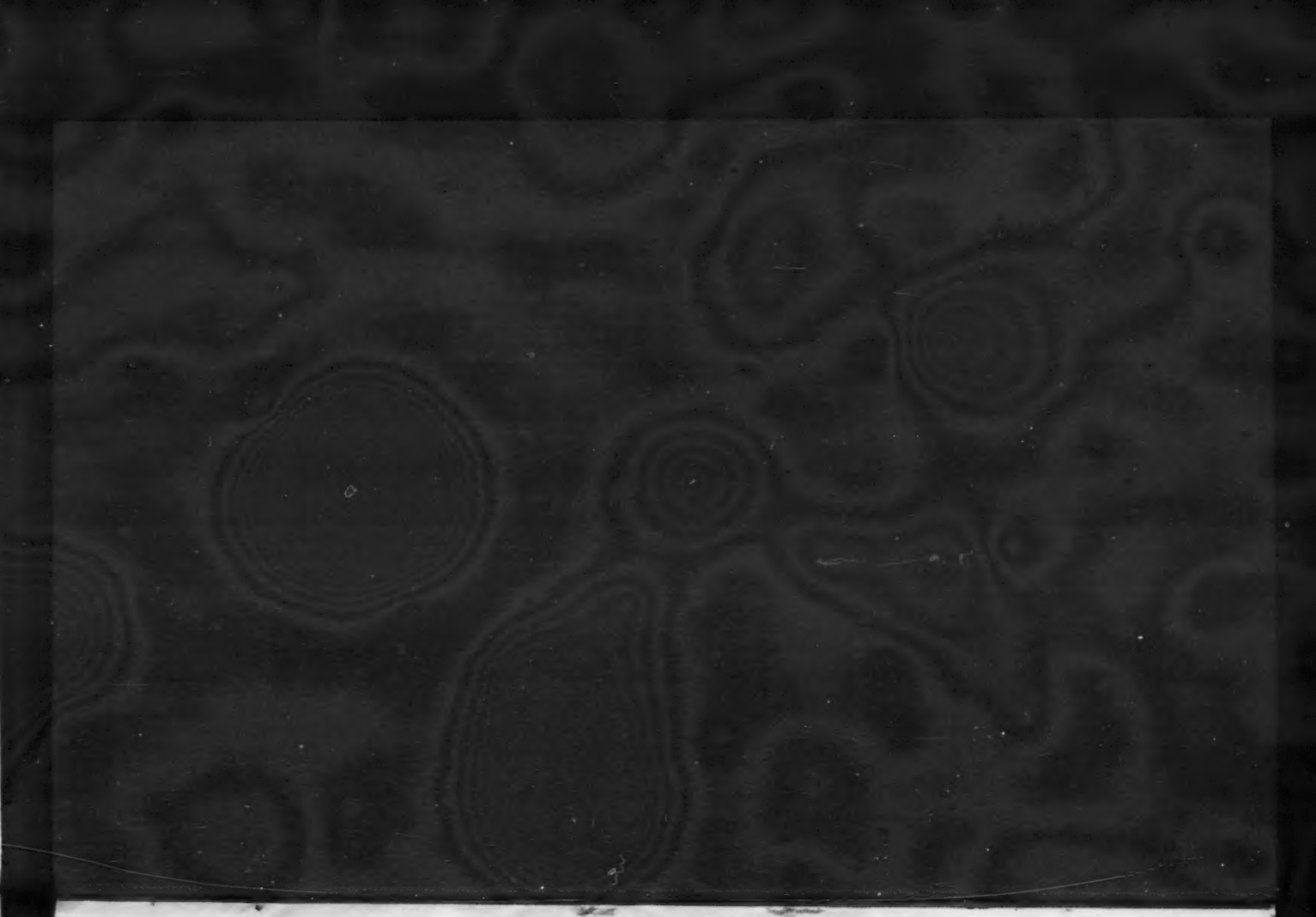
GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4705, intended particularly for the central station manager. The publication deals with turbines of both the low-pressure and the mixed-pressure types, and those with horizontal and with vertical shafts.

Telephones.

WESTERN ELECTRIC CO., 463 West Street, New York City.—Bulletin No. 1,105, describing in detail intercommunicating telephone systems, together with wiring diagrams necessary for their installation. All parts of the instruments are described in detail and well illustrated. It furnishes valuable information to those who are interested in intercommunicating telephones.

Transformers.

WESTERN ELECTRIC CO., 463 West Street, New York City.—Bulletin No. 5270, describing Type T transformers. It is well illustrated, showing the features of design and construction. The descriptive matter gives complete information concerning the different essential parts.

Ventilators.

ROYAL VENTILATOR & MFG. CO., 434 Locust Street, Philadelphia, Pa.—Profusely illustrated catalogue of the Royal system of ventilators for factory, shop, office or other buildings.